THE REPERTORY OF ARTS, MANUFACTURES, AND AGRICULTURE.

No. XXVIII. SECOND SERIES. Sept. 1, 1804.

Specification of the Patent granted to George Woods, *of Barbican, in the City of London, Gentleman; for certain new Methods of constructing Harps, Harpsichords, Pianofortes, Violins, and Guitars, and other stringed Musical Instruments.* Dated June 28, 1803.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said George Woods do hereby declare that my said invention consists in fixing to the strings, at one or both ends, pullies, beams, levers, or other mechanical powers, in such a manner that one movement shall effect the whole, or a considerable number, of the strings, altering the tension of the same; and that these tensions, as far as the friction and imperfection of machinery will allow, shall be increased or decreased either equally or in geometrical proportions; but it will generally happen that equal tensions for the whole instrument will answer the purpose, and that such machinery will be much more

easily made. Before I proceed to describe the construction of any one instrument, I will briefly explain the principle on which my invention is founded, and afterwards the manner of adapting it. I do not know of any piece of mechanism with so little friction, or so likely to answer the present purpose, as the beam or steel-yard, made as the scale-beam, or in any way so that the three knife edges, one at each end, and the other generally in the centre, may touch the same straight line, and be parallel, that is at right angles, with the sides of the beam.

Should the edges be in the least out of the line, there will be only one situation in which the tensions at each end would be equal, and consequently the machinery could not answer the requisite purpose, *viz.* that of preserving to all the strings, as nearly as possible, a certain tension. I may here premise, that when an instrument is in tune, there are only three circumstances which can possibly make it discordant, *viz.* alteration of length, of diameter, of tension; and, independently of the last, I believe it will rarely or never happen that the two first will occasion any difference of tone perceptible to the ear. The grand object therefore is to preserve an exact equality of tension; and so long as this can be preserved the instrument will be in tune. It is then obvious, that if the contrivances hereafter mentioned succeed in preserving or restoring this exact equality of tension, an instrument, when once properly in tune, will continue so without the necessity of continual recourse a tuner.

One of the simplest instruments on the new construction will be the Æolian harp. Let the box or sounding board be made in the usual manner, but rather wider and longer; and let there be, as usual, twelve or eight pegs, on which to wind the catgut at one end. At the other end

end is to be fixed the machinery; and, as short levers require much greater exactness of workmanship than long levers, it may be better not to make the whole length of the beam from knife-edge to knife-edge less than three-fourths of an inch.

Fig. 1, (Plate XII.) is a plan of the machinery on the proposed scale. In the first course are six beams pulling the twelve strings, all the knife-edges being at equal distances on their respective beams. In the next course are three beams, each end of these pulling each middle of those in the former row, and all the knife-edges being at equal distances as before. In the next course is only one beam, each end pulling the middle of a beam in the row before. In the last row is only one beam, one end pulling the middle of that in the former row, and the other end pulling the middle of the remaining beam (*a*) in the second row. This last beam having eight strings to pull at one end, and only four at the other, must not have its knife-edge in the centre, as in this case each of the four strings would be stretched with double the tension of each of the eight, but the distance between the edges at each end must be divided into three equal parts, and the edge (*b*) placed at the distance of one part from the edge (*c*). By this means, supposing the power at (*d*), the tension will be equally distributed through the twelve strings. While all the tensions remain dependent on each other, and detached from every thing else, any laxity of one string will be communicated to the rest. Suppose, for instance, the string at (*e*) was to relax one-fourth of an inch, the end of the beam at (*f*) would move back nearly one-eighth of an inch, the end of the beam at (*g*) would move back nearly one-sixteenth of an inch, and the end of the beam at (*c*) would move back nearly one-thirty-second of an inch, an

equal tension being still preserved through all the strings. In order to make as little friction as possible, it will be better to keep all the beams nearly at right angles with the strings; and this situation, if lost, may be easily recovered by turning the pins at the farther end of the strings.

The beams may be made of two thin pieces of brass, with the knife edges between; and these may also answer the purpose of rivets by fixing the sides parallel to one another; or the beams may be one solid piece of brass, with the knife edges projecting on each side. The steel of which the edges are made must be hard, and those of different beams may be connected by a piece of steel-wire, as at Fig. 2, or a flat piece with two holes, Fig. 3; the first will be best for the connection between the steel edges and the strings. The end (*d*) in Fig. 1, may be easily fixed by a bolt or screw, and the harp may be strengthened underneath.

In making choice of the catguts care should be taken to get them as nearly as possible of one thickness, and their diameter should be measured by a sector of the same kind as those made use of to measure wires, but of greater length and accuracy, and steel edges are to be preferred. By the sector which I make use of I can measure wires, if not very thick, to the $\frac{1}{40000}$ part of an inch; if catgut twisted with wire be thought desirable, the proper size will be easily found by a few trials of those of different thicknesses. The bridges may be variously constructed, and perhaps the following method may be best.

Just before the machinery fix one bridge, of hard wood, or any suitable substance, long enough to support all the strings. This must be exactly on a level with the strings, so that they may pass it with very little friction.

From

From each end, and from the middle of this bridge must project, one firmly-fixed pin, with a screw at the top, passing through a piece of wood above similar to the bridge below, the edges meeting as in Fig. 4. The edges must be so formed that when pressed together they may touch every string, and a thin smooth piece of leather glued to one side may be found an advantage. On the screw of each pin must be a nut, in order to press the two bridges together, and the manner of using which will be presently explained.

At the other end of the instrument each string must have a bridge, with a notch at the middle to keep it steady, hollowed a little underneath, and made rough to prevent its slipping; brass may be the best material. Having given a proper tension to the whole, the strings must be brought into unison by varying their lengths, moving each bridge separately by the fingers or a forceps; for, however nice the measurement of the diameter may be, it is not likely to be perfect. During the operation of tuning, the upper bridge must not be screwed, but only pressed with the hand against the other whenever the vibration of the string shall be tried. The instrument being tuned, screw the bridges firmly together, and it is ready for use. Whenever it shall be out of tune, separate the two bridges, to let the strings and machinery play freely; again fix the bridge, and the instrument, if accurately made, and if the relaxation is not exceedingly great, will be again in tune.

In making a square pianoforte the chief object is to get the beams into a small compass; and to accomplish this I make use of four rows of beams, which I will call one course, one above another, as represented in the elevation, Fig. 5, being a drawing on the exact scale *. Fig. 6, an elevation, shews the same course again, being

* Reduced in the plate to one-half.

of the darkest tint, and their manner of communication with the next course being of the middle tint, and also the communication of this latter course with the one still farther from the strings being the third course, and of the lightest tint. The pieces of steel, uniting the different courses, must be twisted to the requisite angle. The direction of the beams in the different courses, as shewn in Fig. 6, will readily shew what this angle should be. After the twisted pieces of steel joining the third to the fourth course, they will all be flat, and the beams will be placed in one plane, as represented in the plan Fig. 7, on the exact scale *. The wires are to communicate with the first course by hooks, Fig. 2, as in the Æolian harp.

The machinery here represented is for a pianoforte without the additional keys. For one with the additional keys, the following alterations must be made. In the first course must be eight more beams (suppose them put any where in the middle, as the form of the ends will continue as they are, the regularity of situation being still preserved throughout). In the second course will be four more beams, the same situation as at present both in the middle and at the end being kept. In the third course will be two beams more; and, in the fourth one, still keeping the present order. This beam we will now suppose to be the right-hand beam, as at (*a*) Fig. 8, which is to communicate with the last beam of all, being one behind the beam (*b*) in Fig. 7. To preserve an equal tension, the lever (*b c*) must be eight times the length of the lever (*d c*) in Fig. 8.

It is evident, that if the wires from the hooks were all parallel, the hammers could not strike them, they must therefore cross, as in the elevation Fig. 9, and there will be a straight line at (*a*) throughout the whole of the strings; and at this place the hammers may strike, being

* Reduced in the plate to one-half.

at

at much the usual distance from the bridge; between one wire and its unison at the machinery end is one-fourth of an inch, but at the other end the distance must not exceed one-eighth. The right hand of the instrument must be made strong, as the whole of the tension will be concentrated into one part, where the piece of steel communicating with the last beam is to be fixed. The manner of fixing it is immaterial, if it be perfectly firm; perhaps it will be better to have the iron turn partly round the wood, as in Fig. 10. If the addition be thought worth the expense, this end instead of being fixed may communicate with a mechanical apparatus (joined to the instrument) in such a manner that by turning a handle this end shall be drawn backwards. The object of this addition would be to increase or decrease the tension of the whole instrument with greater facility. The machinery must be over the sounding-board without touching it, and just beyond is to be the bridge, about an inch wide.

At about the middle of the bridge each wire is to have fixed to it a round piece of brass, of the form Fig. 11, about one-eighth of an inch thick, and one-fourth or three-eighths long; a slit must be cut of a proper size for inserting the wire at the centre, and not only the two sides pressed together, but, in order to keep the wire firm, the two ends must be bent a little out of the right line, as in Fig. 12, and this operation may be easily effected by a pair of pinchers, cut at the end, as in Fig. 13. The bridge consists of one straight piece of wood fixed to the sounding-board, of two end-pieces, and of a top, all firmly united; the space between the top and bottom being about an inch and three-eighths. At the side of the bridge farthest from the machinery are several oblique bars of wood, where vacancies are made by the wires, in order to prevent the slipping through of the pieces

pieces of wood within. In the inner part are eight pieces of wood, metal, or other substance, of the length of the internal part, and one inch wide, being one-tenth of an inch thick at one side, and tapering to a feather-edge at the other. Fig. 14 is a transverse section, the lines represent the strings, and the marks (<) shew those parts where wedges of the whole length are to be inserted; these wedges will much resemble the other pieces of wood. On forcing in the wedges, the strings will be firm, and on withdrawing them, the strings will again have free play. These wedges in the pianoforte are to be used on the same occasion as the nuts on the screws of the Æolian harp; the direction in which the wires pass the bridge, being part of the longitudinal elevation, is represented in Fig. 15, and also in Fig. 24. Fig. 24 is an elevation of the bridge, with a section of the wires passing through it, and also shewing the situation and manner of fixing oblique bars of wood before mentioned. These wires in number and situation are such as will be used for an instrument with the additional keys; and if the previous description of such instrument should not be sufficiently clear, this figure will tend to elucidate it. An instrument with 144 strings (72 notes) will have the lowest note on the bass ※C and, the highest note on the treble ♮C.

At the back of the instrument are pins, on which to wind the wires in the manner of those made by Broadwood: by these the tension is to be increased or decreased, and the beams brought to their proper situation. Before these pins is a bridge, about two inches wide at the bass end and one inch at the other; and it may be so formed that the first three octaves, besides the strings for the additional keys, may be made of wire of one thickness: my calculations for the thickness of strings will

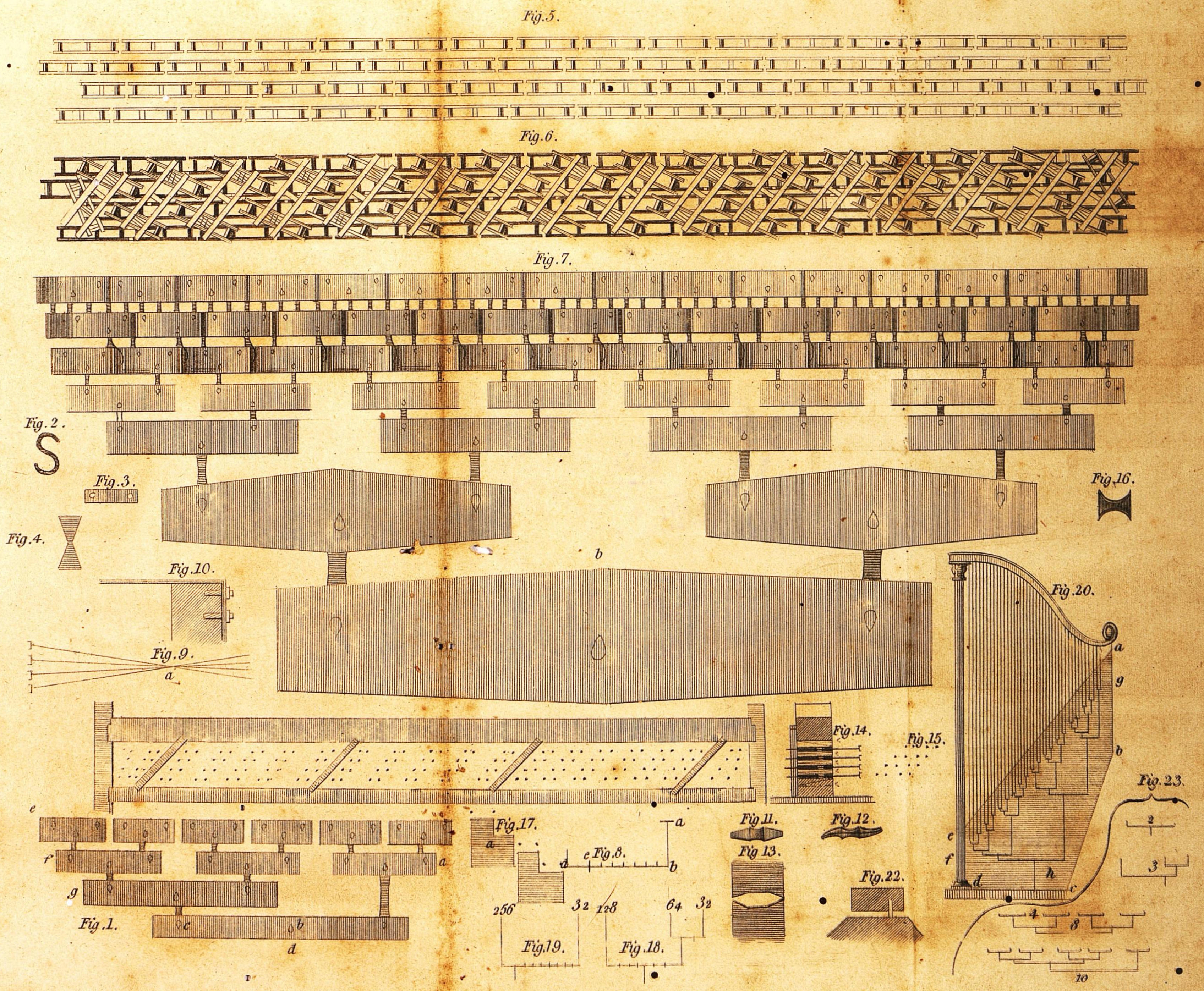


Fig. 5.
Fig. 6.
Fig. 7.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 16.
Fig. 10.
b
Fig. 20.
Fig. 9.
a
Fig. 14.
Fig. 15.
Fig. 23.
Fig. 17.
Fig. 8.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 22.
Fig. 1.
Fig. 19.
Fig. 18.
256
32
128
64
32
2
3
4
8
10

Fig. 4.

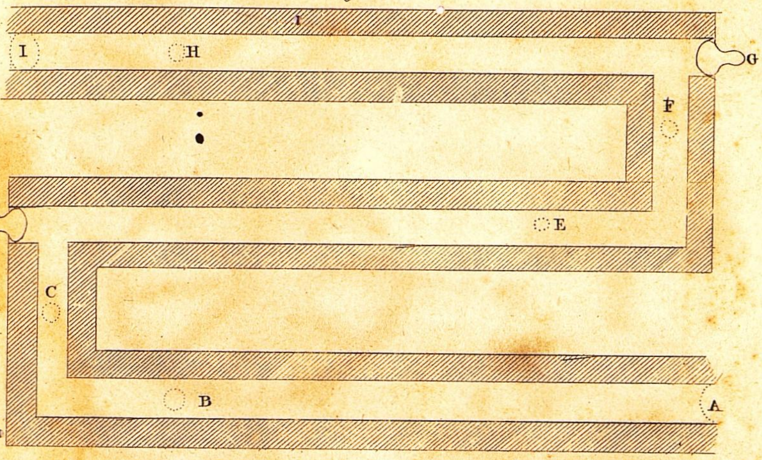
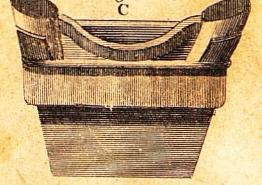


Fig. 3.



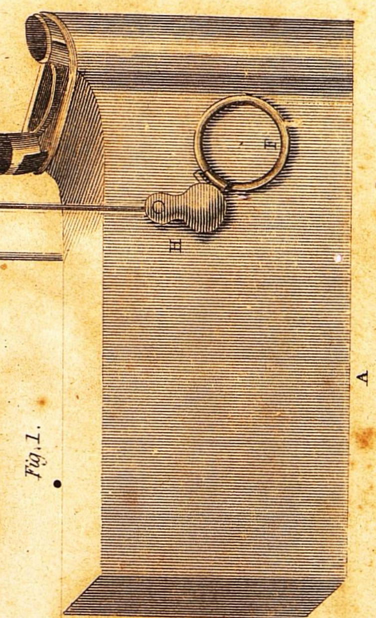


Fig. 1.

Fig. 2.

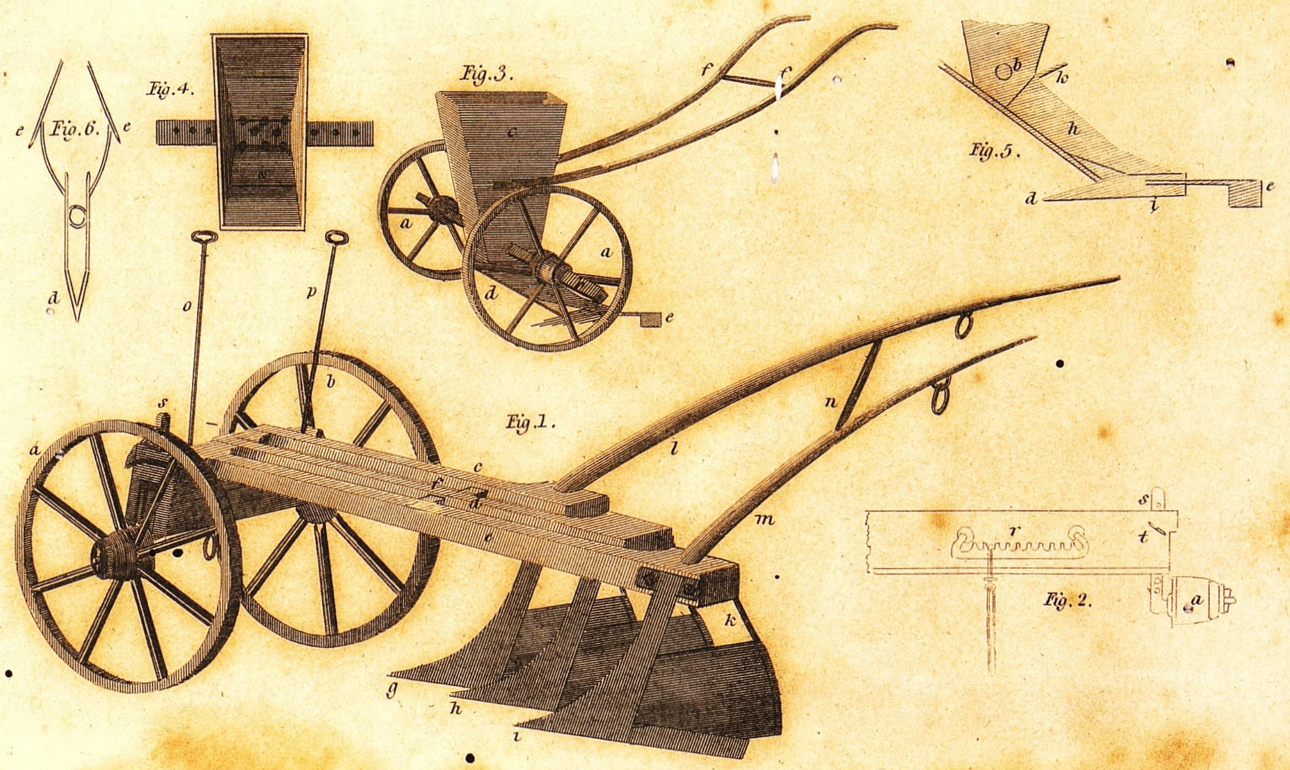


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.

will commence at thirty-two inches in length, and the farthermost string in the bass I propose to be about fifty-six inches. The above-mentioned bridge is to be grooved in such a manner that the bottom of every groove is to be parallel to the wire passing over it; hence there will be one groove for every two strings (unisons) excepting for two notes at each end, where there must be a groove for each string. The wires would touch the bridge the whole distance were it not for a piece of brass, with a hole through, of any other regular shape than round, one-fourth of an inch long, and one-eighth thick at each end; the ends must be made sharp, so that when once placed they cannot move. Fig. 16 is a section, the wire will touch only at the middle. These pieces of brass had better first of all be turned, and afterwards hollowed at one part, as a round form would not keep them sufficiently steady. One of these being put on each wire over the bridge, and the thickness of the wires being properly regulated, agreeably to the instructions presently to be given, the instrument must be tuned, for, however nice the calculations and experiments may be, they probably will not be perfect. To effect this operation, the wedges of the bridge on the right hand must be put in, no firmer than to make the vibration stop at the brass, sufficiently to ascertain the note. It will perhaps be better occasionally to remove them in order to let the strings move freely. A tension sufficiently great to render the notes distinct being given, the strings are to be tuned by lengths, as in the Æolian harp, by moving backwards or forwards the little brass bridges. The strings being tuned, their tension may be increased, and a pin, staple, or screw is to be fixed behind every brass bridge, pressing the wire to the bottom of the groove, thereby making the angle of the wire in passing over the bridge less obtuse. The wedges are now to be driven tight, and

 the

the instrument is ready for use. The angle which the wires make with the back of the instrument may be much the same as usual.

In case I should make any mistake in the following calculations, I refer to "Emerson's Miscellanies, London, 1776," page 361; where

d being the diameter;

l the length;

t the tension;

v the relative number of vibrations;

$$\frac{\sqrt{t}}{d\,l} = v.$$

And *d* being the letter wanted, I reduce the equation thus:

$$\sqrt{t} \,..\, 1.$$

$$\frac{1}{l} = v\,d.$$

$$\frac{1}{l}\,v = d.$$

The vibrations decrease geometrically towards the bass. See p. 383, Emerson. We may denominate C in treble; at which note my calculation begins 100,000, this wire and all above being of one size, and we will call its length thirty-two inches. The strings of each note increasing three-fourths of an inch in length, the requisite vibrators will therefore be as follow: 100,000 C in treble 94.387 B 89.090 * A 84.090 A 78.370 * G 74.915 G 70.711 * F 66.742 F 62.996 E 59.460 * D 56.123 D 52.973 * C 50.000, C lowest in the treble.

These numbers ascertain the quantity of vibrations in each note, and the questions are solved by the aforesaid equation. In stringing the treble of the instrument the length of the strings will be exactly in an inverse proportion, that is supposing the length of the wire sounding the lowest C in treble 100,000, the length of the octave above

above must be 50.000. ✻C will take the place of B as mentioned above, being 94.387, and D the place of ✻A 89,090, proceeding in the same manner through the gamut.

In all instruments where the strings have the same length and tension as in the violin, guitar, and some others, the diameters will increase exactly in the same proportion as the lengths did in the former instance when the diameters and tensions were the same. The proportionate diameters of the wires will therefore be for the pianoforte as follow:

Lowest C in treble 31.250

B	32.350	B octave below	50.753	B octave ditto	81.194
✻A	33.506	✻A	51.608	✻A	85.519
A	34.721	A	53.749	A	89.327
✻G	35.998	✻G	56.000	✻G	93.325
G	37.338	G	58.355	G	97.527
✻F	38.745	✻F	60.827	✻F	101.93
F	40.223	F	62.783	F	106.56
E	41.774		66.142		
✻D	43.401		68.997		
D	45.109		71.993		
✻C	46.902		75.136		
C	48.780		78.431		

By

By repeated experiments with the sector, of wire of different numbers, and of different manufacturers, all these sizes will probably be found sufficiently accurate; but should this not be the case, wire must be made accordingly. Whenever a wire breaks, care should be taken to put on another of a similar size. The wire here mentioned is all plain, and the requisite size of twisted wire when used must be ascertained by experiments. The whole of it also is supposed to be steel. In order to find the relative vibration between strings of steel and of brass, make this experiment. Take one wire of each, of similar diameters, and extend them with equal tension, render them unisons by regulating the length, *c* all the length *l* as before; then say,

As $\frac{1}{l}$ of steel wire : $\frac{1}{l}$ of brass wire : : *d* of steel wire, as by preceding calculation : *d* of brass wire sought.

In the same manner may be tried the relative vibrations strings of any different materials.

In harpsichords and grand pianofortes the wires must not any of them be vertical to each other, as in Fig. 15, but may be arranged as in Fig. 17. The machinery will be between the keys and the wires, consequently the wires cannot make one straight line where the hammers strike, as in the square pianoforte. Great strength is always requisite in that part where all the tensions are concentred. In harpsichords the jacks must be of different lengths, proportionate to the distance of the wire, from the part of the keys in the inside of the instrument; and in grand pianofortes it will be better to have four unisons instead of three, and the hammers will be in the shape of *a*, Fig. 17. The general construction will be very similar to that of the square pianoforte: should the beams occupy too much room they may be a little shortened. In the harpsichord with additional keys must be 224 strings

strings pulled in the first case, as described in the square pianoforte, but afterwards in three united, as in Fig. 18, all the tensions being equal. In the grand pianoforte with additional keys will be 288 strings with beams, arranged as in Fig. 19, all the tensions being equal. I scarcely know the best construction for the pedal harp, and none that can be used without diminishing the elegance of its form. The following will answer the purpose: the upper part of the instrument may be made as usual, but the sounding-board or box instead of projecting at the bottom must project at one side, and the strings must pass over it in a parallel direction, as represented in Fig. 20. *a b c d e* represents the sounding-board; and the place where the strings are united to the board may be on the line *f g*, the calculations and experiments being made with the greatest security, and the machinery being behind, as in other cases, the strings may be all in one plane, the levers being short and accurately made, in order to take up less room. The levers may be placed as in Fig. 20. The machinery may have a cover over it below the sounding-board. The instrument must be made strong enough to support the united tensions at *h*, and the end of the piece of steel *h* may be fixed as in the pianoforte Fig. 10.

The strings will be forty-two in number, arranged as in Fig. 20, or if found more advantageous the tensions may be varied, giving to the bass strings a greater tension than the higher ones. They may easily be varied at every four or every eight strings by altering the length of the lever, the calculations being made as before directed. Supposing the lowest note on the harp to be D, and the uppermost C, and supposing the length of the longest string to be forty-seven inches and two-tenths, and of the shortest five inches, the diameter (on equal tension

tension being given to all the strings) will be in the following proportions.

Notes, all natural.	Lengths.	Diameters.
D	,472	,12104
E	,464	,10724
F	,456	,10513
G	,448	,09535
A	,44	,086465
B	,43	,079153
C	,42	,076194
D	,41	,069528
E	,40	,06350
F	,39	,061460
G	,38	,056206
A	,37	,051412
B	,36	,047161
C	,35	,045714
D	,34	,041927
E	,33	,038485
F	,32	,037456
G	,31	,034449
A	,29666	,032064
B	,28333	,029916
C	,27	,029630
D	,25666	,027769
E	,24333	,026095
F	,23	,026057
G	,2166	,024557
A	,2033	,023386
B	,19	,02234
C	,17666	,022655
D	,16333	,021870
E	,15	,021166

Notes, all natural.	Lengths.	Diameters.
F	,14	,021404
G	,13	,020536
A	,12	,019820
B	,11333	,018703
C	,10666	,018753
D	,10	,017860
E	,0933	,017018
F	,0866	,017301
G	,08	,016686
A	,07	,016983
B	,06	,017658
C	,05	,02000

These calculations are intended to give merely the relative diameters. The catguts of a proper size are to be sought for in the same manner as the wires before mentioned; having previously been stretched with a tension greater than the instrument requires, each string must have a bridge somewhat similar to that of the Æolian harp. This bridge must be so contrived at the bottom that by pressure it may firmly fix into the sounding-board, by means of one or more points or edges. Each bridge must have a top. This top may be attached to the lower part by a pin, which is to move up and down, as at Fig. 22. Between these two parts will pass the string, and for the larger ones the bridges may be notched The strings are to pass over without pressure, and are to be tuned by the placing of the bridges, as in other instances. These bridges, however, must never be moved so much out of the straight line as to make any perceptible discordance of sound when the pedal shall be used. And whenever a string cannot be tuned without so doing, another of a proper size must be placed in its stead.

stead. If strings of a proper size cannot be easily procured, they must be made on purpose. Above these bridges is to be one piece of wood, of sufficient length and breadth to cover the whole number. Several pins from the sounding-board, with screws at the top, are to pass through; and the instrument being tuned, this board is to be firmly screwed down by means of nuts at the top. Great care must be taken to let it pass equally against all the bridges. And this being the case, all the strings will be firm, and the instrument ready for use. The upper board is to be loosened when any of the strings are out of tune; and if necessary the upper part of each bridge slightly raised, and the strings having had free play, it is to be again pressed down. In making violins, violincellos, guitars, and other instruments where the notes are produced by stopping the strings at certain lengths, the greatest nicety of workmanship, and accuracy of measurement, are requisite. In other cases we calculated by diameters, and tuned by lengths; but in the present instances the lengths and tensions are invariable. We must therefore ascertain the diameters with the greatest accuracy, the strings being previously stretched with a greater tension than the instrument requires; and by repeated experiments we shall find that string which, with a given length and tension, will produce a certain note. The calculations respecting their relative thickness may be made as before directed.

The diameters of the strings of the violin and violincello will be in the following proportion: 18.729 28.061 42.045 62.986, and the proper size of silver and catgut if used must be ascertained by experiments. In the common guitar of ten strings we will suppose the wires of the same material; and if tuned to the following notes

notes the numbers against each will shew their relative diameters.

C	50.000	1	string.
E	39.865	1	"
G	33.371	2	unisons.
C	25 000	2	"
E	19.932	2	"
G	16.685	2	"
		10	

The harp-guitar having all its strings of plain catgut and tuned to the following notes, the proportionate diameters of the strings are marked against them.

F	74.914	1	string.
G	66.742	1	
C	50.000	1	
E	39.865	1	
G	33.371	1	
C	25.000	1	
E	19.932	1	
G	16.685	1	
		8	

The lute tuned to the following notes will have the annexed diameters.

F	74.914
G	66.742
A	59.460
B	52.972
C	50.000
E	39.865

G	33.371
C	25.000
E	19.932
G	16.685

At the end at which the pegs are now placed is to be the beam-machinery. In order to fix the same more easily, the end may turn up instead of down. The manner of fixing that part in which the tensions are united is not material; but friction is to be avoided as much as possible. Before the beams, is to be placed a bridge similar to that in the Æolian harp. At the other end of the instrument, the strings, having passed the bridge as usual, are to be wound upon pegs or pins. The end of the instrument being made strong, they may be fixed near that place where, in the violin, there is generally a knob to support the unjoined tensions. These are used to increase the tension of the strings, and to regulate the position of the beams. It may be adviseable to have the machinery moveable by means of a string communicating to that piece of steel on which the last beam is suspended, to be wound on an axis in a similar manner to that of altering the tensions of the strings on the double-bass on the present construction. The object is to vary the tension with greater facility than could be done by turning the pegs at the other end. Fig. 23 represents the plan of the beams for 2, 3, 4, 8, and 10 strings respectively.

Thus have I endeavoured to shew, as clearly as possible, the methods of adapting my principle to various instruments. The application is so perfectly new, and in some few parts apparently so complex (though in itself simple), that I am afraid it will occasion considerable time and trouble even to one conversant in the business, before he will be able in every respect to comprehend my description.

The

The science of mathematics is one, of which so many are ignorant, that I would gladly have excluded every part of it from this specification, but I found the introduction unavoidable.

Many of the calculations will be troublesome, but I have explained them as well as I could, and have also made references; by attending to which the reader, if inclined, may easily learn more upon the subject. In most questions respecting vibrations, and particularly where the tension varies, logarithms will be found of great assistance.

Note. Such parts of instruments as are to be made upon the usual construction I have generally passed over in silence.

In witness whereof, &c.

Specification of the Patent granted to John Porter, *of Lemonville, near Tandragee, in the County of Armagh, in Ireland; for his Invention of a Lamp upon a new Construction.* Dated May 30, 1804.

With an Engraving.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said John Porter do hereby declare that my said invention is described in manner following; that is to say: The distinguishing character of my automaton lamp is, that it is suspended on an axis, on which it moves while burning. On the side of this axis, which is opposite to the burner or burners, the lamp contains the greatest part of the oil or spirits; and on the same side of the axis with the burner or burners is placed so much metal, or

other substance, as makes the lamp hang level, or nearly so, when full, and gives it a dip on the side of the burner or burners, forming an angle of forty-five degrees when empty, more or less; the axis also is so adjusted, with respect to the depth of the lamp, that it may feed itself evenly by the gradual descending of the burners. The principle may be applied to a variety of forms. The annexed drawing is only intended to shew it in a simple way. (See Plate XIII. Figs. 1, 2, 3.) A, the lamp ready to be lighted. H, its axis of motion. G, the suspending wire. B, a front view of the lamp. C, the burners when taken out to introduce the oil or wick. F, a ring, for a weaver to carry it on his finger when mending his warp.

In witness whereof, &c.

Specification of the Patent granted to JAMES HITCHCOCK, *of the Parish of St. Andrew, Holborn, in the County of Middlesex, Gentleman; for his Invention of changing and converting Skins of Parchment and Vellum into Leather, and of making such Leather Water-proof.*

Dated September 15, 1800.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said James Hitchcock do describe and ascertain the nature of my said invention, and the manner in which the same is to be performed, as follows; that is to say: First, soak the skins of parchment or vellum in water for twenty-four hours; then take them out of the water, and rince them well. Having thus prepared them, take any number of skins, not exceeding fifty, and immerse them in the following manner. To twenty gallons of water add

add one pound and an half of white copperas, bruised very fine in a mortar, one ounce of sal ammoniac and one pound of cream of tartar. Let them remain for twenty-four hours, often stirring them well about; then strain off the liquor into another tub or vessel, and mix there-with one pint of spirit of marine salt, one pound of spirit of nitre, and ten pounds of oil of vitriol. The skins put into this solution should be constantly rubbed, washed, or stirred about, until they have discharged all the lime, which will be generally done, if properly attended to, in the course of twenty-four hours, more or less. When the skins treated thus should become soft and pliable, and free from lime, then they must be taken out of the solution, and immersed in clear river water, letting them remain therein for twelve hours to extract the remaining particles of the acids; and they are to be rinced out as dry as possible, without tearing the skins, and put into the following decoction. Take twenty pounds of oak-bark, five pounds of elm-bark, three pounds of lignum vitæ chips, three pounds of sassafras, and seven pounds of shumach, put them into a large copper, and add twenty gallons of water; boil the whole gently for twenty-four hours; then strain off the residue, and let it cool until blood-warm. Then dip the skins therein regularly one after the other for about five minutes, after which put them into tan-pits, with a weak solution of oak-bark only, or with shumach, and let them remain until they are sufficiently strong or tanned, which will generally be accomplished in four or five days, more or less. To make the parchment or vellum thus prepared water-proof, it must be soaked for five or six days in nut or linseed oil; then taken out and wrung as dry as possible. After which it must (being first stretched on a board or other flat surface) be spread with a wooden or metal tool,

tool, made for the purpose, or brushed over several times with the following composition. Take one pound of red lead, one pound of litharge, one pound of copperas, one pound of sugar of lead, one ponnd of resin, one pound of bees-wax, and one pound of pitch; put them into seven gallons of linseed, nut, or fish oil, and boil them in an iron or earthen pot until the mixture becomes of the consistence of treacle, which, when cold, may be spread with an iron or wooden instrument upon the surface of the leather, or brushed on when warm, or spread when cold, for three or four times, which will be sufficient. Then suffer it to dry for three or four days, and it will be fit for use.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM ALISON, *of Long-lane, in the Parish of Bermondsey, in the Connty of Surrey, Tanner; for his Invention of manufacturing an Article into Leather commonly called Spanish or Morocco Leather.* Dated January 4, 1799.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Alison do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained as follows; that is to say: The article of which my Spanish and Morocco leather is manufactured consists of South America horse-hides. These being dried in the warm climate of that country, all the natural moisture of the hide is completely parched up; it requires therefore considerable management and attention to restore them to their

their original softness as nearly as possible. This is to be effected by putting them into soft stinking water. After laying there five or six days to be taken up; they are then to be spread over the tanners beam, and worked over the flesh side with a knife (such as is in common use in working hides). This operation is for the purpose of breaking the thin film that is formed by being so much dried. After this is done they are to be put down again in the same stinking water, to remain three or four days longer; they must then be taken up. By this time they will be (in general) sufficiently soft, but there may still be a few hides amongst them not soft enough; these may be put down again for a few days more. After the hides have been thus softened they are to be put into lime-water (such as is used by the tanners for the purpose of loosening the hair); in this they must remain about fourteen days: during which time they are to be taken up, and put down again four or five times, in order to plunge up the sediment that may have lodged in the bottom of the lime-pit, and that every part of the hide should receive equal benefit. At the expiration of the fourteen days they will unhair easily in the common way. After being unhaired, the thick parts of the hides must be shaved, so as to render them (as nearly as possible) of equal substance. They are then to undergo the same process as what is generally used in the manufacturing of goat skins into this leather, by putting them into warm water mixed with dogs dung. While in this they must be moved constantly, and worked over a beam with a knife, on both the flesh and grain sides, three or four times, that they may be well cleaned from the grease and filth: the time necessary for this purpose is about two hours. In order to make them mellow, and of a fair colour, they may be put into water made blood-warm, with a layer

a layer of bran spread betwixt each hide; in this they must remain till they begin to ferment. They mnst then be taken up and worked clean by brushing them with a knife over both flesh and grain sides They are now in a fit state to undergo the same process as the goat skins, by being tanned with shumach, and finished off in the same way.

In witness whereof, &c.

On Spirituous Liquors, and the Modes of ascertaining their Strengths by the Hydrometer.

By Mr. Robert Atkins, *of Fenchurch-street, London.*

Communicated by the Author, in a Letter to the Editors.

Gentlemen,

As you deemed the specification of my patent for an hydrometer worthy of insertion in the Repertory of Arts, &c. I hope you will favour me with a place for the following observations.

The revenue arising from spirituous liquors is very considerable; and as small variations in their strengths not only occasion great differences in the duties, but subject the importers in some cases to severe losses and inconveniences, it becomes a matter of great importance to ascertain their strengths, and denote their values with accuracy. To accomplish these objects, various methods have at different times been suggested and adopted. Many of them, as might be expected, are fallacious; but it seems now to be generally admitted, that the strengths of spirituous liquors depend on their densities; the ascertain-

ing

ing of which affords the only criterion whereby we can estimate their relative values. Men of science in all countries have been in the habit of expressing the result of the examination of the densities by the term specific gravity; assuming the weight of water, which has become the standard of comparison, to be 1; or, to increase the facility of computation, 1000.

The specific gravity of the most highly-dephlegmated alcohol that has perhaps ever been produced was about 806 *. It may then be presumed that the numerical interval between 800 and 1000 will express all the variations of density which the alcoholic compounds are found to possess.

The most ignorant persons, therefore, will easily comprehend that the value of a kind of spirituous liquor, the specific gravity of which is 850, must be greater than that of another kind, which may be 900: but it requires a much higher degree of mental exertion to understand the various complex ratios which custom and ignorance have adopted in different countries in order to express this simple idea. For instance, a fluid, the specific gravity of which would be 871 at the temperature of 60° of Fahrenheit, would require the following unnecessary periphrasis to denote its relative value in any language which has been hitherto used in commerce. By a mode of expression, which was suggested about half a century ago, by Mr. Clarke, and which has been much used in England, to express the various gradations of strength of

* This alcohol, which was rectified by those scientific chemists Messrs. Allen and Howard, was procured by slow distillation with the sand-bath, assisted by the absorbency of the muriate of lime, which had previously been deprived of all moisture, by bringing it nearly to a red heat, and then mixing it with the spirit.

 spi-

spirituous liquors, it would be necessary to say that such a fluid was about 4 between 1 to 3 and 1 to 2, or that it was 1 to 3 and 4 *per cent.* over proof. To comprehend these terms requires a previous knowledge of the meaning affixed to 1 to 3; it is said to be this, that three gallons of such a liquor would take one of water to reduce it to the degree of strength which is called hydrometer proof. But 1 to 3 and 4 *per cent.* renders the idea much more complicated, for it will be necessary to bring the 4 parts of 100 to the same denomination as 1 to 3, (or *vice versâ*,) to convey to the mind any accurate notion of its relative value: *viz.* $\frac{1}{3}=\frac{33\frac{1}{3}}{100}$ and $\frac{33\frac{1}{3}+4}{100}=\frac{37\frac{1}{3}}{100}=1$ to 3 and 4 *per cent.* *.

Is it not surprising that, even in this enlightened country, where science and the arts go hand in hand, and where the national revenue derives such an immense supply as it does from the taxation of spirituous liquors, (amounting to between three and four millions sterling annually,) that a system, universally known to be extremely erroneous, which produces continual disputes between the officers of the revenue and traders, should be sanctioned by legislative authority, especially when it is recollected that the aggregate of small errors on the duty, which individually might appear trivial, will amount to a very considerable sum on the whole of this important branch of the revenue?

A much more definite mode of expression, however, and one which has been long adopted by the best informed among our commercial men, is that of *per centages;* for instance, the strength of a similar kind of

* For farther illustration of this subject see "Essay on the Relation between the specific Gravites and the Strengths and Values of Spirituous Liquors," by Atkins and Co. page 26.

spirituous

spirituous liquor to the last-mentioned, the specific gravity of which might be 871, would be termed about 37 *per cent.* over proof; implying that 100 gallons of such a spirit would require 37 gallons of water to reduce it to the strength of *hydrometer proof*.

By Beaumé's areometer the same alcoholic compound would appear to be about 25 degrees of his arbitrary scale, and by that of Cartier about 30.

It is not very probable that there are many persons, however interested they may be in these subjects, who understand the relation which either of these modes of expression may bear to the others; it never I believe has yet been published.

But how much more intelligible to the meanest capacity is the idea which the characters 871 convey to the mind than the above-mentioned expressions, *viz.* 1 to 3 and 4 *per cent.* — 37 *per cent.* over proof; Beaumé's 25 degrees, or Cartier's 30? They all mean to convey the same idea; but it is obvious that it must be difficult to retain in the memory the relation which each bears to the others, at every degree of strength that spirituous liquors are met with in commerce.

The Arabic numerical characters being generally known throughout the civilized world, the commercial man in Russia, Germany, or any other country, will as easily comprehend their value in his own language as we do in ours. How desirable therefore would it be, and how much would it facilitate the operations of the philosopher and the man of business, to disencumber this interesting subject from the technical phraseology with which provincial customs or proverbial maxims have hitherto embarrassed it, and which limits the use of a most delicate and valuable instrument to a very confined employment?

Mm 2 The

The present time seems to be peculiarly favourable for accomplishing this desirable object; for the necessity of establishing some well-digested method of discovering and denoting the strengths of spirituous liquors, appears to be experienced by every commercial country in Europe and its dependencies.

Every one who is in the least degree connected with the scientific or mercantile world must have often found his memory not infallible, and at times may have experienced some difficulty in obtaining a book of reference by which he could ascertain the ratio which the value of any coin, weight, or measure, may bear to that of others which may be in use in the neighbouring states.

In the early stages of society, ere yet nations and provinces had much commercial intercourse with each other, it might be expected that the capacity of their measures, and the value of their weights, would materially differ from each other; and custom having established certain standards, which have become venerable from their antiquity, the propriety of substituting others in their stead may be questioned; but this is not the case with the subject in discussion; the methods of ascertaining the values of spirituous liquors by their specific gravities is yet but partially known in England, and still less so in any other country. This being the fact, the difficulty of establishing some permanent system on a general basis would not be considerable.

I would not presume to recommend any system which could be considered as an innovation on long-established forms and customs. The method I wish to suggest has been long known and practised by the philosopher, but not hitherto adopted by the manufacturer or merchant; if however it were so, it would have the effect of introducing mathematical perspicuity and brevity into the operations

operations of the financier and trader, when considering either the relative values of spirituous liquors or the rates of taxation which the different kinds of them may bear.

Neither would it be necessary, even in England, to make any alteration in the established laws respecting the exciseable degrees of strength at which the distillers and rectifiers are allowed to make, or the merchant to import spirituous liquors. I would only propose to express those strengths which are mentioned and described in the statutes relating to this subject, in a more definite and intelligible manner.

The specific gravity of hydrometer-proof spirit has been long assumed to be 920 at the temperature of 60° of Fahrenheit; this, however, is only by a kind of tacit agreement between government, the merchant, and the hydrometer-makers. 1 to 10 over proof, according to Clarke's hydrometer, is about the specific gravity of 909½; 10 *per cent.* over proof, however, which Mr. Clarke meant by 1 to 10, is 907; 1 in 10 under proof is about the specific gravity of 930½, say 930; 1 in 7 under proof is about 935; 1 in 6 under proof is nearly 937; and 1 in 5 about 941; all at the temperature of 60°. These, I believe, are the only strengths which are mentioned in the British statutes; it would therefore only be necessary to pass an explanatory act of parliament, directing that the barbarous terms, which have been hitherto used to express the various degrees of strength of spirituous liquors (which are a disgrace to an enlightened nation) should be hereafter discontinued, and the above-mentioned numbers, or any others that may be deemed more eligible, be substituted for them.

It is only of late years, however, that this subject has become so interesting, in consequence of the increased consumption

consumption of spirituous liquors, and the considerable revenue that is derived from them. Formerly it was thought not difficult to discover the value of a gallon of brandy by the bead, or chapelet as the French call it; but it having been found that a weak compound of alcohol and water might be made to exhibit the same appearances as the stronger ones, by the addition of some foreign matters, which affect the specific gravity but little, the hydrometer was resorted to, in order to detect the impositions that were practised by the fraudulent dealer.

The first instrument of this kind that was used in commercial transactions was that of Mr. Clarke; and before a better method was known, it was certainly a valuable one; but that it gives erroneous indications of strength has been long demonstrated to the world, and more simple and accurate methods have been devised — methods by which the revenue which the government derives from this source might be much improved, without increasing the rate of taxation on the commodity; and the uncertainty which the distiller and merchant at present labour under, in consequence of the indefinite terms and confusion of tongues (if I may be allowed the expression) which now embarrasses them, would be entirely removed.

To the manufacturers of spirituous liquors, and to the merchants who deal in them, it is of the greatest importance that this business should be finally settled by legislative authority. The distiller and rectifier are liable to very heavy penalties if any part of their stock is found above a certain degree of strength, which is very inaccurately defined in the language of the acts of parliament relating to this subject; and it often happens, that on the examination of their stock by the excise officer, the instrument which he uses may indicate that a very large quantity

quantity is really liable to seisure, whilst another may denote quite the reverse: *the consequences of this to the distiller and rectifier may be easily conceived.*

To the merchant who imports a cargo of foreign brandy it is a still greater desideratum. There is a particular strength defined by act of parliament, beyond which this spirit is not admissible into Great Britain; but it is the custom of the trade, and their interest so to do, to purchase it in France, &c. as nearly this degree of strength as possible. Foreign spirituous liquors, which are the produce of the British colonies, are liable to a very considerable additional duty if they are imported beyond what is technically called the "*escape-strength*," and an excess of .001 in specific gravity renders such a spirit liable in the one case to seisure, and in the other to an additional duty of one-tenth more: Clarke's hydrometers, however, frequently differ from each other more than .003 or .004; and notwithstanding the great number of weights annexed to them, they do not pretend to indicate more minute differences in specific gravity than .005 or .006. Hence it is not an uncommon occurrence for a whole cargo of brandy, which may be worth from fifteen to twenty thousand pounds, to be seized by the officers, and detained some time to be more accurately examined, if not to be ultimately confiscated, when the real degree of strength that it may possess is within the limits which the law allows. Instances of this kind have frequently occurred, and specimens of cargoes under such circumstances are often brought to me for examination.

Such is the instrument which some few persons, either from ignorance or interested motives, still contend is sufficiently accurate for the purposes of the revenue, and the important interests which are connected with it!

It

It is, however, well known that there are many persons who derive considerable emoluments from sources which are connected with the revenue arising from spirituous liquors, and the application of this hydrometer to discover their value. They have perhaps by their influence retarded the ultimate arrangements of this business, which ought to have been settled long before this time; particularly as it seems so generally acknowledged that the present system is so defective, and the simple question — which is the instrument that is best adapted for these purposes? — has cost the nation so many thousand pounds.

To the retail dealers in spirituous liquors, which includes a large portion of the community, (comprehending all those who are generally called wine and brandy merchants, tavern-keepers, and publicans,) it is likewise an object of the greatest magnitude. If I chose to avail myself of the means which I possess of obtaining a large fortune in such a way, I should find that one half at least of the quantity of spirituous liquors which are in possession of the above description of persons would be liable to forfeiture, in consequence of their being inferior in strength to the limits which the laws prescribe. But the deficiency of information of the excise officers on this subject leaves open a door to much imposition and fraud on the revenue and the public. At the same time it frequently happens, that the ignorance of the inferior class of publicans in this respect exposes them to the risk of losing the whole of their stock in consequence of the illegality of its strength.

It is not a little extraordinary, that this subject should be supposed to be involved in such obscurity, for it certainly is as easy to ascertain the degree of strength and relative value of a gallon of brandy, or any other kind

kind of spirituous liquor by the hydrometer, as it is to weigh a Cheshire cheese in a pair of scales: the one only depends on the accuracy of the beam and weights, and the other on that of the hydrometer. There are but few people who would be disposed to purchase a cheese or a joint of meat by the estimated weight of it in hand; yet we find the generality of persons daily purchasing large quantities of spirituous liquors, without the means of judging whether they may not be deceived in the value of it to the amount of three or four shillings *per* gallon. It seems to be thought lightly of to pay a guinea *per* gallon for a large quantity of water when mixed with brandy or rum, which is very often the case; but to pay ninepence *per* pound for an article that is only worth sixpence, is considered to be the extreme of folly.

The subject of hydrometry has been lately investigated in a very scientific manner by M. Barré, of Orleans *: he appears, however, to have been extremely ignorant of the degree of perfection which it has attained on this side of the water; for the ideas which he suggests, and similar methods to those which he has adopted to graduate his scale of densities, (which he has denominated the "general areometrical scale,") have been long known and practised among us: but the knowledge which he displays in his researches deserves high commendation, and it may convey much information to his countrymen; indeed every mathematical reader must be delighted with the manner in which he presents his ideas to the public: but he seems not to have known either what has been published on the subject in England, by Dr. Robison or others, or that there have been instruments made here for these ten years past according to the prin-

* Inserted in the preceding number of this work, p. 207.

ciples which he considers to be new; indeed he acknowledges that the areometers of Beaumé and Cartier are the only kind which he knew of.

The observations of M. Barré, however, suggested to me the propriety of giving a concise description of the following hydrometer, which I have been in the habit of making many years, but no general explanation of it has hitherto been communicated to the public. It is constructed only to express specific gravities from 800 to 1000; but it is equally easy to graduate it for any range of densities whatever.

The four sides of the square stem of this instrument are graduated with divisions, which represent specific gravities in thousandth parts of unity. It is adjusted to the temperature of 60° of Fahrenheit. The side of its stem, which is marked 0 at its superior extremity, is representative of the intervals of specific gravity between 800 and 850; the hydrometer, without any of the detached weights, will therefore subside in any kind of spirituous liquor, or other liquid, that is between those extremes, until its stem is intersected by the surface.

The side of the stem which is engraved with a 1 at the top of it, is intended to be referred to when the instrument, with the weight marked 1 suspended on its shank, is immersed in a fluid, whose specific gravity is between 850 and 900; the division therefore on this face of the stem, which the surface of it may intersect, will be indicative of its specific gravity.

The next side of the stem is marked 2 at the upper end of it, which must be referred to when it is found necessary to load the instrument with the weights marked 2, in order to make its bulb subside below the surface of a fluid in which it may be immersed. The graduations on this face of the stem will therefore, in such case, indicate

cate specific gravities from 900 to 950, which will express the degrees of strength of those kinds of spirituous liquors which are most usually met with in commerce.

The remaining side of the stem to be described is marked 3; and when a fluid in which the instrument may be immersed requires it to be loaded with the largest weight No. 3, the graduations on this face of the stem will point out all differences in specific gravity between 950 and 1000.

These graduations, however, are not a series of equal parts; if they were so, they would become a scale of bulks in arithmetical progression, but they would not indicate weights of the same bulk in this proportion. The specific gravity is as the weight divided by the bulk. A series of divisors therefore, in arithmetical progression, which in this case would represent the volumes of the displaced liquids, compared with a constant dividend, which would be the bulk and weight of the hydrometer as it floats in water, will not give a series of results in the same ratio. These results will be a series of harmonic progressionals, their differences continually diminishing, such therefore must be the divisions on the stem of the instrument, in order that it may indicate equal changes of specific gravity. These may be determined either by calculation or by a scale of harmonic progressionals. If the instrument be graduated entirely by experiment, by making a number of fluids of different specific gravities, and marking the stem as it stands in them, which has been the way commonly practised even by the most esteemed artists, the divisions will turn out very anomalous. This is one reason why there are so few hydrometers made that hold true to a single division or two. I consider the method by calcula-

tion however to be more exempt from error than any other can possibly be.

But to return to the subject which is more immediately under our consideration. The variation in the densities of spirituous liquors, arising from a change of temperature, and consequently their *apparent* increase or diminution in value, renders it necessary to adopt some method of determining their relative values at the standard temperature to which the hydrometrical indications refer.

The specific gravity of proof-spirit and water is usually assumed for the temperature of 60°; therefore any kind of liquor, the strength of which is to be examined, must be reduced to that temperature practically, or by finding from registers of experiments what correction must be applied for the difference of its temperature from 60°.

In order to ascertain what the effect of temperature may be, the only certain guide is experiment; the law of expansion being not only different for alcohol and water, but for all the various compounds of them. The degree of heat too at which these two fluids, uncombined, arrive at their maximum of density, is likewise very different, water being (according to some late experiments of Mr. Dalton) at its greatest degree of condensation at 42½°, and alcohol at about 30°.

For the purpose therefore of ascertaining the relative values of spirituous liquors at different temperatures, one of the following methods must be resorted to.

First, by diminishing or increasing the heat of the spirit under examination until it be brought to the required temperature, but which at times would be found to be a troublesome operation.

Secondly, by the compensation weights for temperature.

Thirdly,

Thirdly, by the sliding rule, which is both an elegant and simple method.

And, fourthly, by reference to a set of tables, which I have calculated for the purpose from my own experiments, compared with those of Sir Charles Blagden and Mr. Gilpin. My results coincide so nearly with those of the last-mentioned gentleman that the accuracy of either cannot be doubted.

Of these methods, the third is now I believe generally preferred to any other, by every one who pretends to be competent to form an opinion on the subject.

This sliding rule is constructed merely to answer the following question; the specific gravity of any spirituous compound at an observed temperature being given, what will it be at any other determinate one? We can resolve this question by Mr. Gilpin's tables; but it is rather a tedious process, and difficult perhaps to those who are not much used to arithmetical computations. I can answer it more readily by referring to the tables which I have calculated, but a similar objection will somewhat hold good with respect to them. We can, however, apply to the sliding rule, and obtain the solution in an instant.

Respecting the most proper degree for our standard temperature, I consider 60° of Fahrenheit to be the most eligible, because it is about the mean degree of heat which we experience in the laboratory, the office, and the counting-house.

We will therefore suppose that the sliding rule be adapted to this temperature.

After having previously ascertained the specific gravity and temperature of a specimen of alcohol under examination, we may refer to the rule, and instantly discover what will be the specific gravity of it at 60°.

Let

Let us exemplify this by supposing that we have some brandy, the temperature of which is 75°, and we find its specific gravity to be 914: it is required to ascertain what its standard specific gravity may be, that of distilled water being assumed to be 1000 at 60°.

The operation by the sliding rule is nothing more than to set the asterisk on the slider against the seventy-fifth division on the "*thermometer scale;*" and on looking among the graduations on the side of the rule for the division corresponding to 914, we shall find opposite to it the graduation marked "920," or "*proof;*" therefore such a kind of spirituous liquor would be deemed exactly of the strength which is termed "*hydrometer proof.*"

I think it must be obvious to every one who considers this subject with that attention which it merits, that the best method of ascertaining and denoting the relative values and strengths of spirituous liquors is that which is most intelligible to mankind in general. That the preceding observations may tend to produce the effect of establishing the system which they recommend is what I scarcely presume to hope, though it would be most desirable and advantageous to the community, in consequence of the facility which it would afford to our commercial intercourse with other nations.

Were I to consult my own interest on this subject, it would censure me for urging such remarks, because the hydrometer that will ascertain the specific gravity of spirituous liquors may likewise be made to ascertain that of any other liquid; for when the divisions on the scale are solely adapted to any particular business, it renders the instrument useless for every other purpose. Every manufacturer therefore, by whom liquids of any description are employed, the values of which depend on their specific

cific gravities, might have their hydrometers constructed for general purposes, instead of adapting them to answer those particular questions which usually occur in the various processes to which they are applied.

In order, however, to accommodate the public with a hydrometer for spirituous liquors which might embrace every advantage that it is capable of possessing, I devised the instrument which is described in page 163 of the present volume of this work: it is constructed to indicate their degrees of strength according to the *per* centage mode of denomination, and is likewise accompanied by a comparative scale of the corresponding degrees of specific gravity, Clarke's mode of denomination, and those of Beaumé and Cartier.

This instrument possesses some practical advantages which may be worth mentioning.

If the strengths of a large number of newly-imported samples of spirituous liquors be under examination, the temperature of the whole being nearly the same, which I understand, in the practical consideration of the subject, is usually supposed to be the case, without immersing the thermometer in any sample but the first; it will be only necessary to immerge the hydrometer successively in each, without changing or removing any weight, and the degrees of strength may be read off from the stem almost as rapidly as a person can note them.

The *per* centages are likewise to be very easily distinguished even by the most ordinary eyes, for they are about the tenth of an inch distant from each other; the faces of the stem, which affords a large surface for containing the graduations in consequence of its being prismatic, are more than one-fourth of an inch wide; and the strength of a sample-phial of spirits may be ascertained

tained by it which contains no more than one-third of a pint.

This instrument, however, when it is used with the compensation weights for temperature, may indicate erroneous results; but the maximum will not be more than half or three quarters of a *per* centage when employed for discovering the strength of those spirits which are commonly met with in the market.

If therefore this small error be deemed unimportant in the practical consideration of this subject, when put in competition with the celerity with which the operation may be performed, and it be deemed adviseable to continue any of the present modes of denoting the strengths of spirituous liquors, I will venture to assert that this instrument is by far the best that has ever yet been constructed either for the purposes of the revenue or the merchant, as it saves all trouble of calculation, or reference to the sliding rule or tables, unless those methods be preferred.

The results which may be obtained in the above-mentioned way by this instrument may likewise be verified by removing the compensation weight for temperature (or, more concisely expressed, the thermometer weight) from the top of the stem, and referring to the third face of it, which is graduated with a series of equal parts, that bear reference to the sliding rule, consequently those who are content with the approximation towards the truth which the thermometer weights afford may use them; whilst the person who wishes for more philosophical precision may refer to the sliding rule, or to a set of tables adapted to the instrument which I shortly intend to publish.

With this rule, or the tables, it will then indicate all the degrees of strength of spirituous liquors from alcohol to

to water, and every corresponding degree of specific gravity from 800 to 1000.

The public are therefore in possession of an instrument, adapted to ascertain the strengths and values of spirituous liquors, that combines all the real or supposed practical advantages which every other hydrometer possesses that has hitherto been constructed for the purposes to which this is intended to be applied. Every individual may therefore use it in any way which his fancy or leisure may dictate, or he may ascertain the accuracy of one mode of computation by comparing it with any other.

I am, Gentlemen,

Your most obedient,

Fenchurch-street, humble servant,

August, 1804. ROBERT ATKINS.

Description of a Three-furrow Plough. Invented by the Rev. EDMUND CARTWRIGHT, *of Woburn, in Bedfordshire.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted to the Inventor.

THE plough which I have invented has occasionally been at work through the whole summer. Though a very useful instrument at all times, it is particularly valuable at the seed times and the turnip season; because at those times it frequently happens you lose the most favourable opportunities, for want of ability to execute your operations with sufficient dispatch.

I need not calculate to you the saving on the use of this plough. It is worked (on light land I mean) with a pair of horses, without a driver. A pair of horses and a ploughman cannot be estimated at less than 8*s.* *per* day. As two sets of these are saved, the weekly saving by the use of this plough amounts to no less than 4*l.* 10*s.*

Useful, however, as I find this instrument on our light level lands, I am not so partial to it to suppose it is equally calculated for all soils, or all kinds of ground. For instance, where the ground is very uneven, or the ridges are narrow and steep, I would not use it, neither when the land is very foul with root-weeds. In all these cases a single plough is certainly to be preferred; but in all cases where the ground is in a tolerable state of cultivation, and where it lies reasonably level, it will be found a most valuable acquisition.

The saving of hands, and consequently of expense, in a plough of this kind, is obvious; but why there should be a saving of power may require to be explained.

I need not observe, to any one who considers the action of a common plough, that a very material part of the labour in ploughing arises from the friction of *the land side* and the *sole;* of the one against the side of the furrow, and the other against the bottom. In a single plough a certain length and width are required in those parts of it, to make it go steady; and even then the effect would be imperfectly obtained, did not the ploughman assist by the average of the handles of the plough. Hence it is clear, that the less disposition any plough has to follow the draught in a straight line, the greater is the labour of working it, because the ploughman in that case is to exert a greater power of leverage to keep it steady. On the contrary, when two, three, or more ploughs are combined, they serve to steady each other, and require,

com-

comparatively, very little power of the lever to keep them in a straight line. Under these circumstances, neither the first nor second plough has any sole or land-side whatever, and even the third does not require so much of either as a single plough. I calculate the saving of power, from this consideration alone, as equal at least to one plough. What farther power is saved I attribute to the lightness and compactness of this instrument.

I am willing to think the simplicity of its construction, and the manner of fixing the plough (consisting but of two parts) to the beam, will not escape observation. When the cutter (for as it is both coulter and share I can give it no other single name) requires to be sharpened, or new laid with steel, by drawing the two bolts the whole is set at liberty.

I make the ploughs to fit each beam indiscriminately, because when the land is too strong or too foul to work the three, I take off the second plough, and transfer the third into its place.

You will observe the centre of the whipple-tree shifts. By this contrivance the power of the horses are equallized, though they may be unequal in strength, the longer lever being given to the weaker horse.

Reference to the Engraving of the Three-furrow Plough, Plate XIV.

Fig. 1, *a b*, the two wheels of the plough, the wheel *b* being full one-seventh in diameter larger than the wheel *a*.

c, *d*, *e*, three beams of the plough, of which *c* is the shortest and *e* the longest; these beams are fixed in the strong cross-piece *f*, at equal distances from each other, and braced by another cross-piece from *c* to *e*.

 g, *h*, *i*,

g, h, i, the three cutters, which answer the purpose of both coulter and mould-board, each being formed together, or made of one piece of beaten iron. Each cutter is screwed to its beam by the flanging-iron *k*.

l, m, the two handles of the plough, the lower extremities of which are fixed in the two outer beams *c, e*, and connected by a cross-piece *n* to make them firmer. The handle *l* is longer than the handle *m*, in the same proportion as the beam *c* is shorter than the beam *e*.

o, p, two upright pieces of iron fixed in the cross-piece *f*, having two holes at their summits for the reins to pass through, which guide the horses.

s, an iron bar, which slides up and down near one end of the cross-piece *f*, to raise or lower the wheel *a*.

Fig. 2, shews a detached portion of the strong cross-piece *f*, to explain the manner in which the whipple-tree shifts (*r*) one fixed in front of that cross-piece, so as to regulate or equallize the power of the horses.

s, a bar of iron, the lower part of which forms the axis of the wheel *a*, the upper part slides in a groove in the cross-piece *f*, and has holes at different distances. It may be retained at any height by an iron pin *t*, which passes through the cross-piece and one of the holes of the iron-bar. The real plough is nine feet long to the extremity of the handles, and each cutter turns a nine-inch furrow, from centre to centre of the beams being nine inches.

Description

Description of a Hand-drill for sowing Peas, Beans, &c. Invented by Mr. ROBERT GREEN, *of Westwratting, in Cambridgeshire.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal and Ten Guineas were presented to Mr. GREEN *for this Invention.*

I HAVE invented an engine to sow peas, with which I have sown all my peas, to the amount of forty acres, at the price of 1*s. per* acre, and think that my peas are much better than those sown any other way. It is also on a very simple plan, and the expense of it when complete is not 2*l.* It is used by manual labour, without any horse; and it will draw the drill, sow the peas, and cover them at the same time, and will sow them much rounder than any other I have yet seen. I likewise find I can do it much cheaper than with any horse. I am of opinion that it sows much better than any drill I have seen.

I have sent the engine * for sowing peas, in order that it may be laid before the Society for the Encouragement of Arts, &c. I intended to have sent the model of it, but afterwards thought that the engine itself would be more acceptable to the Society.

I made it myself, and have sown with it twenty-six acres of land in my own occupation. Mr. Piper, a near neighbour of mine, has sown with it five acres; and Mr.

* Preserved in the Society's repository for public inspection.

Cock, of Blunts-hall, Wrattling, in Suffolk, twenty-five acres, at the expense of 1*s.* *per* acre. Several other gentlemen had drills of me for sowing peas. If I give my men 1 *s.* 6 *d.* *per* acre, they will sow for me two acres in one day. I can with my own hand sow one acre in five hours, and at the same time sow the peas, draw the drill, and cover them, and make full twelve drills and a half to the rod. I likewise produce the plant much handsomer than any other seen in our county, and at a very trifling expense. By this engine too, the labour of horses is spared, which we find to be a very material circumstance. It will be a most excellent machine for gardeners in the neighbourhood of London; for I will be bold to say, that no man can sow with his own hand, so as to equal this, at a very trifling expense.

I have spent much time in making implements of husbandry; but have made none so useful as this, for it is simple in its construction, may be purchased by any man, and saves the labour of horses.

Reference to the Engraving of the Hand-drill, Plate XIV.

Fig. 3, *a, a,* the wheels placed upon a wooden axis *b*, which is square at each end, but round in the centre. The square ends of the axle have holes throughout them, at different distances, in order to deposit the seed at nearer or more distant intervals, as may be wanted.

e, the box in which the seed is placed: the axis *b* is cylindrical, and has holes made therein proper to receive the seeds, which, by the revolution of the axis, are carried forwards, and fall through an iron tube into the interstice in the ground, opened for them by the share *d*. When deposited in the ground they are covered, or the earth drawn over them by two iron pins or scrapers *e*,

fixed

fixed on each side of the tube, and extending some inches behind it.

f, f, the handles of the drill machine, by which it is pushed forward.

Fig. 4, shews an enlarged view of the interior of the said box *c* above mentioned, and holes for the seeds, placed in a spiral line, in order to drop the seeds more regularly.

g, is a small brush within the box, which rubs against the cylinder, to keep the holes clear to receive the seeds.

Fig. 3, is a section of the machine, where *a* is a part of the seed-box; *b*, the round part of the axle, which delivers the seed.

d, the space which opens the earth.

h, the tube through which the seed falls.

i, the mouth of the tube, and one of the pins which draws together the soil, and covers the seed.

k, is a small door, to be opened occasionally, if the roller or tube are out of order.

l, a strong flat board, to which the iron-work is screwed.

Fig. 6, shews an enlarged plan of the iron-work when the machine is reversed.

d, is the share.

c, the hole from which the seed is dropped.

e, e, the two pins or scrapers which collect the earth and cover the seed.

N. B. The length of the upper rim of the seed-box of the machine in Fig. 3, being fifteen inches, will serve as a standard for the measure of the other parts.

Memoir

Memoir on Areometers. By M. Barré, *of Orleans.*

(Concluded from Page 217.)

According to this demonstration, it is easy to see that with the aid of G *e* we shall be able to graduate an areometer for indicating the relation, exact within a thousandth part of unity, between the densities of the liquids above which the stalk of this instrument shall be able to float, provided that this stalk be cylindrical, whatever otherwise may be the figure of the part immersed. For this purpose,

1. I take the areometer A B C, Fig. 2, which I immerse in some liquid, the density of which, for example, is expressed by $\frac{30}{100}$ of the principal unity. I mark with precision upon the stalk B C the degree of immersion which I suppose to be at the point B; I plunge the same instrument into a second liquid, the density of which is expressed by $\frac{80}{100}$; and I mark in like manner the degree of immersion which I suppose to be at the point C.

2. With an expansion of a compass, I take the interval B C from the stalk of the instrument; and I carry this interval parallel with the line G E of the triangle between the two obliques drawn from the point C and denoted by the numbers 30 and 80; drawing afterwards a line through the two points of the compass: this line will be intersected by the obliques, in parts proportional to the corresponding spaces of G B.

3. I carry the divisions of this line B C, prolonged as much as the stalk of the instrument may admit, by means of a slip of paper, and I mark each degree with the number belonging to the oblique which corresponds with it; finally, I introduce this scale into the stalk of the instrument, and I fix it, taking care to make correspond with the

the upper mark C the degree denoted by the number $\frac{30}{100}$; and, with the point B, the degree which indicates $\frac{80}{100}$ of density; and the instrument is graduated.

It would be superfluous to enter into farther details to demonstrate:

1. That the case would be the same for every other instrument, though the marks of immersion were taken in two liquids, whose relation of densities were different.

2. That if the spaces AD, DE, EB, are divided each into 1000 parts, we shall be able to graduate the scales of the areometers in such a manner that these instruments shall indicate the relations of the densities in thousandth parts of the principal unity.

3. Finally, that each degree of an areometer will constantly indicate the same density at the same degree of temperature, and that consequently all those instruments will be capable of comparison with each other.

The triangle A C B presents therefore all the advantages which can be desired for dividing the scales of areometers conformably to the laws of hydrostatics *. But in

* Independently of this property, this triangle has others which may perhaps render it susceptible of some useful applications in the arts. The inclination of F E towards A B, which is capable of being varied *ad infinitum*, like the magnitude of the angle A E F, furnishes an infinity of series of spaces, whose relations, being subject to a constant law, are determinable in all the degrees of inclination. The prolongation of E F beyond C F presents new series by its intersections with the obliques drawn indefinitely through the point C to the prolongation of C B. Each series of spaces may be considered as the representatives of a particular curve, capable of being subjected to calculation, and which in some cases may enjoy certain properties, &c. &c.

For a long time past, I have been inclined to suspect that the divisions of the thermometer were defective like those of the areometers, though in a less evident degree. Bodies are in general more dilatable by

in order to put it in every artist's power to construct these instruments well, I think it incumbent upon me to enter into some details with respect to the manner of dividing them expeditiously and with precision, and to the precautions necessary to be taken in order to render these instruments capable of comparison.

II. In order that the areometers, constructed by different artists, at all times and in all places, may be susceptible of comparison, it is necessary that the data, which are to serve as bases, should be fixed and invariable; consequently they must be derived from nature; nothing that is arbitrary should enter into the construction of these instruments.

Distilled water, at a determined degree of temperature, presents a constant density which nature offers nearly uniform in all countries. The density of this liquid may therefore be considered as a fixed and invariable base, and serve as a term of comparison for the specific gravity of all liquids in general.

As sensibility and exactness are essential qualities in an areometer, and as it is only required that each instrument be immersed into two liquids, of different densities, in order to be graduated, every artist will be able to con-

by a given quantity of caloric in proportion as they are more rare; consequently equal quantities of free caloric, accumulated successively in a body, add to its volume quantities which must increase more and more according to a particular law for each body. Several, such as mercury, do not, perhaps, present differences in their degrees of dilation sufficiently sensible to be appreciated; but alcohol, other liquids, and especially the elastic fluids, which are not to be rejected for measuring the temperature, present differences in their degrees of dilitation. If the law which the degrees of dilatation of any body follow were well determined, it would perhaps not be impossible to find in the line F E of the triangle A C B a degree of inclination proper for giving the exact divisions of the thermometrical scale.

struct

struct ich as shall be exact at least within a thousandth part of unity.

For this purpose he must be furnished with a certain number of liquids, of different and arbitrary densities; b... the relation of each of which, with the specific gravity of distilled water, and at a determined temperature *, is accurately known. Each of these liquids will be a base not less fixed and invariable than that of distilled water, and equally derived from nature, since the expression of its density depends upon that of a liquid whose density is constant and uniform.

Consequently it is of essential importance that the artist should assure himself, in various ways, at several times, and with the greatest attention, of the specific weight of each of the liquids which are to serve as a base. A good hydrostatic balance, with glass plungers, and several very sensible gravimeters, in order to vary and repeat their operations so as to take the mean term of their results, if they differ, afford means which may be depended upon. The new (French) weights, divided into decimal parts, also facilitate and abridge the operations by a calculation more simple, and less subject to error, than would be performed with the varied fractions of the ancient weight.

The gravity of each liquid, when once well ascertained, will be disignated by the expression which belongs to it, in thousandths of the weight of distilled water.

* The temperature of 15 degrees of Reaumur's thermometer (18,75 degrees of the centigrade thermometer), as being the most usual in our climates, seems to deserve the preference. Moreover, by referring to the degree of temperature, indicated upon the instrument any liquid the density of which we wish to know, we shall have its exact relation with the specific weight of distilled water.

The artist having once determined the relation of the density or specific weight of each liquid with that of distilled water, will be obliged to verify them from time to time, in order to avoid the errors which might be occasioned by the slightest variation in the densities. He will avoid long and troublesome operations, by making for each liquid a small areometer, of extreme sensibility. The slightest change in the density, and even in the temperature, will be very sensibly perceived by the more or less considerable immersion of the stalk of this instrument.

Though it be a matter of indifference, whether arbitrary or determined densities are taken, yet it would however facilitate the graduation of the scales, as will appear hereafter, to choose in preference liquors whose densities were expressed in round numbers, such as 0,500, 0,600, 0,700, &c. from the lightest ether to the most concentrated sulphuric acid. We may, by different mixtures, procure all these determined and intermediate densities, if we make instruments of very great sensibility and precision; for the sensibility will be in the proportion of the length of the stalk and the inverse of the difference of the extreme densities which it will indicate.

Every instrument being once adjusted for the densities which it is to indicate, requires, for the exactness of the results, very great precautions in its immersions and in the precision of the marks which are to serve as the points to set out from for its graduation.

1. The instrument, after having been taken out of one liquid, must not be immersed in another without being previously well washed and very carefully dried. Without this precaution, changes would be imperceptibly produced in the densities, and frequently in the temperature of the liquids.

2. The

2. The marks of immersion, to the number of three at least, for reasons that shall be assigned, must be made with the greatest care at the surface of every liquid, and be of distances as far from each other as the length of the stalk will permit.

3. Each areometer, in its different immersions, must bear a paper of weight equal to that upon which its scale is to be marked. This paper presents the advantage of bearing the expression of the densities of the liquids which have given the marks of its immersions.

Every instrument, provided with two fixed points, which will constantly indicate the same densities, will indicate upon the space comprehended between these two points all the intermediate densities. This space must comprehend as many degrees of indication as are marked by the difference of the numbers which express the extreme densities; and every degree must be denoted by the number which expresses the density of the liquid, which this degree indicates by the immersion of the instrument.

If the spaces intermediate between these two points of immersion, and those which each instrument will be capable of bearing beyond them, are proportional to the corresponding spaces of the general areometrical scale, represented by G *e*, Fig. 3, all these instruments will be capable of comparison, since each of them will indicate exactly the density of each liquid compared with that of distilled water.

Now, in order to fulfil the purpose which I have proposed to myself, it only remains for me to explain the manner of applying the triangle A C B, Fig. 3, to the graduation of the areometers, in order to enable an intelligent artist to employ it with success and expedition, and to make the degrees of his instruments proportional

to

to the corresponding degrees of the general areo[illegible]etrical scale. What I am about to propose is capable [illegible]f being carried to further perfection, but it will be sufficient to enable an ingenious man to make a trial of this method, when it will be in his power to contrive and substitute, in place of the means which I have proposed, processes more ingenious, more expeditious, and more exact.

Upon a well-united plane, of an arbitrary size, and at least twice as long as it is broad, take a point C at a small distance from one of the large sides, and at some distance from one of the small ones; from this point C, Fig. 4, parallel with the large side, and in all its length, draw a line C B and one C D, forming with the first a right, or nearly a right, angle, and draw D B to form an isosceles triangle B D C. Take at the middle of B D a point E, and divide each space E B and E D into 100 or 1000 equal parts, according as you may wish to graduate the instruments for indicating the densities only in hundredths or in thousandths of the principal unity. Finally, from the point C, through each point of division taken upon B D, draw an oblique, and mark all these lines with the series of natural numbers, beginning from the line B C, which marks the zero of density. All the spaces of B D, beginning from the point B, are in arithmetical progression, and represent the densities expressed upon the obliques drawn from the point C, B E represents the principal unity of density, and B C a double density.

From this construction it results, that every line, H E, drawn in the plane parallel with C B, is divided by the obliques into parts proportional to the spaces of the areometrical scale, and that each point of division indicates the degree of density expressed by the number which corresponds with it.

I think

I think it necessary to observe, 1, that this sliding plane ought to be traced with the greatest accuracy, and that a large dimension should be preferred; 2, that it is not a matter of indifference of what substance this plane is made, and that a plate of copper combines advantages superior to those of any other; 3, that instead of determining B D in order afterwards to divide this line into 200 or 2000 parts, it would be preferable, for the sake of precision, to carry 200 or 2000 times an opening of the compass taken at will upon B D indefinite; afterwards through the point of the last division to draw D C, and form the triangle B D C. This triangle, though arbitrary, possesses advantages, being rectangular at C; the intersections of B D, and of the parallels H E, approximate in general more to the right angle, which is not to be neglected. The obliques beyond E H must pass exactly through the equal divisions of the prolongation of B D: the manner of tracing them is easily found. Moreover, I consider these lines to be almost superfluous, because, if we except mercury, there perhaps exists no liquid whose density is much superior to double that of distilled water.

To complete the construction of this dividing plane, there must be adapted to it two parallel rules, moveable one upon the other, and made of metals with much precision. The one of these two rules must be fixed invariably upon one of the large sides of the plane, and parallel with C B; the other rule, moveable, must traverse the whole breadth of the plane, without its parallelism being susceptible of variation; and some mechanical means must fix this rule, moveable at each of the points, which it traverses upon the breadth of the plane.

What has already been said, and the inspection of the apparatus, might suffice instead of a description of its use;

use; however, in order to obviate every difficulty, the following is the manner in which it must be employed.

Having taken, with the necessary precautions, two points of immersion upon the stalk of an areometer, in two liquids, whose specific weights are, for example, expressed by $\frac{800}{1000}$ and $\frac{1400}{1000}$.

1. With an expansion of the compass take exactly the distance between these two points of immersion.

2. Advance the moveable rule upon the plane as far as the point where it will give the distance between the obliques, marked with the numbers 800 and 1400, equal to the expansion of the compass, and fix the rule in this position. Afterwards, in the direction of this rule, and beyond the obliques which are to determine the degree of the scale, place the slip of paper upon which this scale is to be traced, and upon which the proper lines have previously been drawn.

3. Carry successively one of the points of a compass upon the points of intersection of the rule with the obliques, and with the other point of the compass, whose distance must be regulated in proportion to the place which the slip of paper shall occupy, trace the degrees intermediate between the two points of immersion and those which the paper will be capable of bearing beyond them.

4. Finally, write at each point of division, from five to five, or from ten to ten, the number with which the oblique which corresponds with, and which has determined it, is marked; introduce this scale into the stalk of the instrument, and be attentive to make correspond exactly, and in the proper order, the numbers 800 and 1400 with the two marks of immerson which are noted upon the stalk.

Operating

Operating in the same manner upon each of the other areometers, all these instruments will be capable of comparison, whatever otherwise may be the densities of the liquids which have determined the points of immersion.

According to the explanation of this method, and the principles upon which it is established, it is evident that we may construct areometers of extreme sensibility, and of the greatest precision. For this purpose it will be sufficient to make the stalks long and slender comparatively with the bulk of the instrument; but then it will be necessary that the dividing plane be made of sufficiently large dimensions, since each stalk will in this case contain only a small part of the total scale.

Hitherto I have supposed the stalks of the areometers to be perfectly cylindrical, which however is very rarely the case. In order to remedy, to a certain degree, the defect of cylindricity, it is necessary that we should have upon the stalk of the instrument at least three marks of immersion, and place upon the plane a particular rule, which, by its position, causes to coincide its three points of intersection with the obliques marked by the numbers which express the densities of the liquors which have furnished the marks of immersion of the instrument. I do not assert that this correction will be rigorously exact; but it cannot be denied that it will in some measure counterbalance the conical form of the stalks, a form which moreover must be avoided as much as possible. As this figure renders the spaces smaller in proportion as they approach the large extremity of the stalk, it is proper that the small extremity should be below, in order not to diminish the inferior degrees, which already are naturally smaller than the superior.

 What-

Whatever advantages these insruments may possess over those at present in use, I doubt whether they will be substituted instead of them in commerce and in the manufactures. New denominations, unequal degrees, will appear to persons who have no other principles than routine, and no other rules than habit, as useless, or objects of mere curiosity. However the arts and commerce will find in the use of these instruments advantages which are not to be found in those of Beaumé and of Cartier, which, independently of the defects essentially inherent in them, have others which arise from their construction, and the negligence of the artists; several are made with printed scales, and do not admit of certain comparison. I know that the artists make what they call strong and weak ones, which means that the one are advantageous to sell, and the others to buy. It is astonishing that government, whose vigilance extends in general to whatever may prove detrimental to the interests of society, has always neglected the verification of the areometers, the accuracy of which is not less important, and their falseness not less punishable, than that of weights and measures.

In order to introduce these instruments into commerce and the arts, it would be proper, 1, that the artist should put upon each a small note, mentioning that every number of the scale expresses in thousandths of the weight of distilled water the density of the liquid whose gravity it marks; that is to say, that if a given volume of distilled water weighs, for example, 1000 grammes, an equal volume of any liquid weighs as many grammes as are expressed by the number which indicates its density; 2, that he should make a table of comparison of the areometrical scale with the divisions of Beaumé, of Cartier, and others. For this purpose he should divide an indefinite

finite line, A B, Fig. 5, into parts proportional to the spaces of the general areometrical scale, marking each division with the number that should belong to it. It would be sufficient if this scale of comparison extended from 0,700 to 2,000. Drawing several lines parallel with this line A B, such as *a b*, *c d*, *d e*, he should place upon each, the division of one of the areometers, which he might wish to compare, and proceed in the following manner.

He plunges into distilled water, at the degree of temperature, which he has adopted for the construction of his instruments, one of the areometers which he wishes to compare, that of Cartier for example. Finding that the point of its immersion is at 10 degrees, he traces a point of division upon the line *a b*, opposite to that marked 1,000 upon the line A B, and marks this point with the number 10. He plunges the same instrument into spirit of wine, whose density is, I will suppose, equal to 0,850, and he finds, for example, that it indicates 35 degrees of the areometer; opposite to 0,850 he traces upon *a b* a second point of division, which he marks with the number 35, and divides into twenty-five equal parts the space comprised between these two points, marking all the points of division with the numbers intermediate 10 and 35, and in the natural order which they must follow. He carries above 35 and below 10 as many divisions as he thinks proper, each equal to those comprehended between the 10th and 35th degree of *a b*, and he marks each of them with a proper number. Operating in the same manner for each areometer, we may see at a glance to what degree of such an areometer a liquid of any density corresponds, by the correspondence of each of the degrees of these areometers with the general areometrical scale.

If the method proposed has inconveniences which I have not been able to foresee, men of ability will be able to rectify it. I should consider my success complete, if by removing some thorns I should have facilitated the discovery of an useful plant to the sagacity of an intelligent botanist.

A very compendious Method of completely saturating Potash with Carbonic Acid. By M. Schnaubert.

From Goettling's Chemisches Taschenbuch.

It would be a mistake to imagine that the labours of the modern chemist leave nothing more to be desired with respect to the means of saturating potash with carbonic acid. In general there is no practical subject in chemistry which is not susceptible of some amelioration, and that with which I occupy myself is perhaps more so than any other. I admit that, in several cases, our purpose may be accomplished by following the processes which have been proposed by Lowitz, Van Mons, Pelletier, Walter, and others; but it cannot be denied that these processes are not always satisfactory, and that the apparatus which they require are too expensive. Hence I presume that a method which remedies these different inconveniences cannot fail to be favourably received by chemists.

But before thinking of such a method, it was necessary that I should previously discover a means of recognizing the most minute portion of free alkali that might exist mixed with the carbonate of potash. This means I have found in acidulous solution of magnesia, which is whitened

whitened by the presence of the smallest quantity of caustic potash. The manner in which I prepared the re-agent is the following.

I inverted over water a large bottle full of this liquid, and I filled it half with carbonic acid gas, and with the aid of agitation I thus saturated the water with this acid: into this acidulous water I put carbonate of magnesia triturated with water, and I agitated it strongly. A considerable quantity of it was dissolved. I filtrated the liquid, and kept it in a cool place, inclosed in a well-corked bottle.

When we instill into a certain quantity of this acidulous magnesian solution some drops of a solution of carbonate of potash which contains the smallest quantity of free alkali, it immediately becomes turbid, and I have found that not only the acidulous magnesia but also its neutral carbonate is decomposed. This solution therefore presents a very sensible re-agent for the caustic alkali. After having discovered this sure re-agent, and found the affinity of the acid to be greater for the potash than for the magnesia, it was easy for me to procure a carbonate of potash completely saturated with carbonic acid. The manner in which I proceeded in this preparation is as follows.

A certain quantity of potash, already in a great measure saturated with carbonic acid, was dissolved in water, and the solution was filtrated. It was heated to ebullition, and carbonate of magnesia diluted with water was added to it till a portion of the liquor no longer precipitated the acidulous solution of carbonate of magnesia. When this point was attained, the matter was poured upon a strainer of cloth, and the magma was expressed; then the liquor which had passed was filtrated through paper, and evaporated to make it crystallize. In this

manner

manner a very beautiful and very white crystallized carbonate of potash was obtained.

It is not necessary to remark, that this method is particularly advantageous when we operate with an alkali already in a great measure saturated with carbonic acid, and that a potash entirely, or in a great measure caustic, requires too much carbonate of magnesia. We may make use of the magnesia which remains from this operation, by washing it well in water, and heating it in a crucible till it becomes perfectly caustic.

Experiments on Raw Platina, on the Existence of several Metals, and of a new Species of Metal in this Ore. By Messrs. FOURCROY *and* VAUQUELIN. *Read to the National Institute.*

(Concluded from Page 231.)

8. FINALLY we wished to ascertain whether it were possible to separate, in the humid way, by means of some re-agents, the foreign matter which exists in the salt of platina. For this purpose we dissolved 8 grammes of this salt in 250 grammes of boiling water; and whilst the liquor was still hot, we mixed with it 8 grammes of dry caustic potash; immediately the liquor assumed a green tinge, and some moments after flakes of the same colour separated from it. These flakes, collected upon a small filtre, the weight of which was exactly known, augmented it, after a perfect desiccation, by about seven centigrammes.

The solution of the yellow salt of platina, treated in the same manner, presented nothing similar; which clearly proves that it is the metallic matter combined with

with the platina in the red salt which is the cause of the green precipitate given by the potash.

The green matter detached from the filtre dissolved in the mineral acids, imparting to them a green colour. This solution, mixed in this state with a solution of pure platina, did not give it the property of affording a red precipitate with sal ammoniac. If we make it boil it loses its green colour, assumes a very deep red one, and thereby acquires the power of causing a red precipitate in the solution of pure platina, with the aid of the muriate of ammoniac.

This green matter, fused before the blow-pipe with borax, was immediately reduced into small white laminæ, having a metallic lustre.

The liquor from which we separated the green matter by potash, and which it appeared ought to contain no longer any other metal than platina, presented to us an interesting phænomenon, the cause of which we are not yet very well acquainted with, but which we think it incumbent upon us here to mention. Muriatic acid poured into this liquor, to the saturation of the alkali, gave a precipitate of a rather sallow-white colour, which, when dried, weighed a gramme and a half. This precipitate, put upon burning coals, fulminated, producing a noise similar to that which takes place when we throw some drops of water into boiling oil, and it was reduced to black fumes. This substance, when slowly heated, detonates pretty strongly, producing a red flame.

In order to know what passed in this operation, and to collect the matter of the fumes, we heated six decigrammes of it in a small mattrass with a long neck; as soon as the heat began to act, some aqueous vapours were raised, the matter was agitated with an extremely rapid motion, during which the kind of fulmination above mentioned

tioned was heard, and at last it remained in the form of black powder, the weight of which was now not more than three decigrammes and a half.

This black powder does not dissolve wholly in the nitro-muriatic acid; it leaves a small quantity of matter, which obstinately resists its action. The portion which dissolves gives to the acid a very intense brown colour, and this solution affords a purple red precipitate by sal ammoniac.

It appears, according to these experiments, that this white matter, precipitated by the muriatic acid, is a combination of oxyde of platina, of oxyde of the new metal, and of ammoniac, which proves that the potash had not precipitated the whole of this substance in the state of green flakes.

The liquor from which the two matters above mentioned were separated had now only a pale yellow colour, and, mixed with a slight excess of muriatic acid, it afforded by evaporation a salt of a pure yellow colour.

9. It now only remained for us to examine the mother waters and the lixivia of the yellow and red precipitates, to which we promised to return. We shall not here enter into all the details of the experiments to which we subjected them, but shall only specify their principal results.

First, we evaporated them to dryness in capsules of porcellain, and washed the residuums with alcohol, in order that we might not dissolve the triple salts of platina which were mixed with them.

We observed, with some surprise, that the triple salt, which remained after the lixiviation of the residuum of the mother waters of the yellow salt, had a lively red colour, like that of colcothar, and that it was mixed only with some yellow points, whereas the triple salt which remained

remained after the lixiviation of the residuum of the mother-waters of the red salt was almost of a pure yellow.

The triple salt of the mother-waters of the yellow precipitate, after having been lixiviated by alcohol, dissolved easily enough in water, and communicated to it a red colour, inclining to a rose, analogous to that of the solutions of cobalt. Potash formed in the cold in this solution a precipitate of the same colour, which became green by the action of heat. The prussiate of potash, aided by a little muriatic acid, occasioned in it a precipitate of a chesnut-red colour, which presented all the properties of the prussiate of copper.

15 grammes 47 centiemes of this red precipitate, heated to redness in a crucible of platina, exhaled oxygenated muriatic acid, muriate of ammoniac, and left five grammes of metallic matter of a dull grey colour.

These five grammes of metal, having been heated by the nitro-muriatic acid, were not entirely dissolved by it; for there remained a black powder, which new quantities of acid did not appear sensibly to attack. This was still a portion of the new metal which had remained in solution with the platina in the mother-waters of the yellow salt.

The portion dissolved in the nitro-muriatic acid had a a brown colour, it gave a red precipitate by sal ammoniac; mixed with an excess of ammoniac, it formed a red precipitate, inclining to the orange colour, and the supernatant liquor had a blue colour, with a slight tinge of green, which it owed to copper and to a small quantity of triple salt which had remained in solution.

It is evident from these experiments, that the residuum of the mother-waters of the yellow salt was formed of platina, of the new metal, and of copper, all three united in the state of triple salt by ammoniac and muriatic acid.

We must therefore add to the already numerous list of foreign substances which we have formed in the entire platina, the presence of copper.

The matters which were found in the alcohol which we had employed for washing the residuum of the mother-waters of the yellow salt, were a large quantity of muriate of iron, muriate of copper, in considerable abundance, and a small quantity of muriate of gold. We do not know as yet whether there be any other matter in it, because our experiments on this subject are not entirely completed.

As to the triple salt obtained from the residuum of the mother-waters of the red salt, it contained no copper, but was formed merely of platina and of a minute quantity of the new metal. The alcohol presented to us nothing but muriate of iron, and perhaps still some portions of salt of platina.

Conclusion.

From the whole of the experiments recorded in this memoir, it results, that crude platina contains five metals foreign to it; namely, titanium, chromium, copper, iron, and a new metal. There is reason to believe, 1, that the chromium and the titanium exist in it, the one in the state of acid, the other in that of oxyde, combined with iron; so that the one forms chromate of iron, and the other ferruginous oxyde of titanium; 2, that the copper and a portion of iron are united in it with sulphur; which would account both for the origin of the sulphurated hydrogen gas which is disengaged when the platina is boiled with muriatic acid, and for the larger quantity of iron in the first solutions of platina; 3, that the greater part of the iron is combined with the platina, since its presence is recognized even in the last solutions of

of the latter metal, however numerous the quantities of acid successively employed may have been.

As to the new metal, we are ignorant whether it be combined with the platina or not; so much is certain, that it can easily unite with it, and even promote its fusion. This metal has appeared to us to be of a greyish-white colour, difficult of fusion, of oxydation, and of solution in the acid; consequently easy of reduction, giving a green oxyde, which combines with the alkalies, communicating to the solutions of platina, when it is united with the acids and in such a state of oxydation that its solution shall be brown, the property of affording a red precipitate of sal ammoniac, existing still in the platina purified by ordinary processes, since we have found it (in small quantity indeed) in that of MM. Jeannety and Necker Saussure.

We may also conclude, from these first experiments, that platina has not hitherto been known in a perfectly pure state, and that in order to obtain it in that state it is necessary to reduce by fire the triple salt of a pale yellow colour.

We shall conclude this memoir by proposing, with respect to the palladium, a conjecture which we shall endeavour to verify hereafter. This alloy does not appear to us to be formed of platina and mercury, but rather of the new metal united with platina.

Finally, we offer this investigation only as a first essay, which we propose to prosecute much farther; for the present, it is sufficient to shew how much interest attends the analysis of crude platina, and to what discoveries it may lead.

Second Series of Experiments on the new Metal contained in Crude Platina.

By Messrs. FOURCROY *and* VAUQUELIN.

IN pursuing our experiments since the day when our inquiry upon platina was presented to the Institute, we obtained some new results, of considerable interest, respecting the new metal which we announced as having been discovered at the same time by M. Descotils and by us.

We said in our memoir, that the platina, as it dissolved in the nitro-muriatic acid, left a black powder, and that it was principally in this matter that the new metal is to be found. Till then we believed that it existed in it in a pure state, or combined merely with a small quantity of platina; but we have since found that this powder is still an alloy, into which chromium enters as constituent principle; at least this seems to be proved by the experiments which we are about to describe.

Experiment I.

Two drachms and twenty-four grains of this powder, put together with a like quantity of potash, were heated for the space of an hour, and the matter was lixiviated with water. The liquor had a brown-red colour: mixed with nitric acid to the saturation of the alkali, flakes of a bottle-green colour escaped from it, the gelatinous appearance of which indicated the presence of silex in them These flakes, as they dried, assumed a very deep colour.

The liquor had then a pretty pure lemon-yellow colour; mixed with a solution of nitrate of silver it gave a very vivid carmine red; with the nitrate of lead a very

pure

pure yellow; phenomena which prove that the potash had dissolved chromic acid.

After having washed the matter fused with the potash, we poured upon it muriatic acid, which immediately assumed a very rich green colour. After this first quantity of muriatic acid we added a second, which, with the aid of a gentle heat, assumed a very fine blue colour.

Notwithstanding these two doses of acid, the whole of the matter not having been dissolved, we treated it anew, and successively, by potash and muriatic acid: the phenomena were the same as the first time. As some matter still remained, the same operation was continued till the effects above mentioned ceased to be re-produced, which required five successive treatments; there then remained only some grains of platina, which had escaped the action of the nitro-muriatic acid.

We think it necessary here to remark, that the successive action of two agents employed is absolutely necessary, in order entirely to decompose the black matter, which seems to prove that its elements are united by a close combination, and that probably they experience some change in the course of these operations.

In order to be able to draw some inference respecting the nature of the black matter, and respecting what passed during its decomposition, it is necessary separately to examine the muriatic acid and the potash.

The muriatic acid, as we have said above, had assumed a very intense green colour: the caustic alkalies precipitated from it green flakes, which re-dissolved in a great excess of these matters, giving them a violet-red tinge. This precipitate fused with borax does not give it a green colour as the chromium does, but it is reduced into white metallic laminæ, some of which, disseminated in the borax, give it a grey colour; as long as it is united to the

the acid with its green tinge, it does not communicate to the solution of platina the property of giving a red precipitate by sal ammoniac, and its colour is not changed by the green sulphate of iron.

The green muriatic solution, heated in a crucible to ebullition, assumes at first a blue colour, which soon passes into a violet, and at last into a deep red, at which it remains without alteration. In this state, and after the greater part of the superabundant acid has been vaporized from it, it gives to the solution of pure platina the facility of forming a beautiful red precipitate by sal ammoniac, though by itself it is not precipitated by this salt. The green sulphate of iron causes it immediately to lose its red colour, and reduces it to the green.

It appears, from these experiments, that this is the metal which gives to the triple salt of platina the red colour which it is known to have; but we see at the same time that it requires to be in a certain state of oxydation in order to produce this effect, since when it is green it no longer produces it. Now as the sulphate of iron, in destroying its red colour, and causing it to pass into the green, deprives it of the property of giving to the triple salt of platina a red colour, it seems evident that it is by acquiring oxygene that it becomes capable of producing this effect; for, to judge according to analogy, the sulphate of iron acts here only as a disoxygenating substance. These new experiments, therefore, confirm the supposition advanced in the first memoir respecting the high degree of oxydation necessary to the new metal in order to colour the salt of platina.

The lixiviums of potash, employed at five successive times, for the decomposition of the black matter, presented the following phenomena: 1, their solutions had an orange yellow colour, perfectly similar in all the five;

2, mixed

2, mixed with a solution of nitrate of silver, they gave a red precipitate of the same cast; with lead, an orange-yellow precipitate, which, fused with borax, gave it an emerald green colour; with the nitrate of mercury, at the minimum of oxydation, a cinnabar red precipitate; 3, finally, these alkaline solutions, saturated with nitric acid and evaporated, gave, among the nitrate of potash, crystals of a ruby-red, which we discovered to be chromic acid.

It might be concluded from these facts, that the potash found and dissolved chromic acid ready formed, and that this was combined with the new metal in the black powder; however, if we reflect that this powder has a black colour, a metallic aspect, a pretty considerable weight, that it blackens bodies like pulverized metals, that it does not dissolve in any acid without a previous oxydation effected during its fusion with potash, we shall be authorised to think that these two substances are in the metallic state in the black powder; and what seems to afford an additional confirmation of this idea is, that chromium does not undergo oxydation or solution without the greatest difficulty, even in the most concentrated nitro-muriatic acid.

If this was the case, the chromium will have been acidified, and the new metal oxydated by the action of the potash, aided by the heat and the atmospheric air.

We must not forget to mention, that the muriatic solution contained a little iron with the new metal, and that this might probably be united at the same time to the iron and to the chromium in the black matter.

All this requires to be verified, and we are assiduously occupied in pursuing our experiments.

Description

Description of a Series of Furnaces known by the Name of Gallies, *the Construction of which produces a greater saving of Fuel and Labour than those in common Use.*

By M. Curaudau, *Corresponding Member of the Society of Apothecaries at Paris.*

With an Engraving.

From the Annales de Chimie.

In the workshops in which nitre is decomposed for the purpose of obtaining nitric acid two means are employed, argil and caloric. The former substance being found abundantly diffused through all nature, may be made use of without the necessity of seeking a substitute from motives of economy. Caloric on the contrary deserves every attention; it cannot be developed in a constant and powerful manner but by the means of substances, whose price is daily augmenting, and the consumption of which the prudent man ought to see the necessity of diminishing. It is with this view that I was induced to propose some alterations in the ordinary construction of gallies.

My principle will apply equally to every case where there are a succession of operations of the same kind, as, for instance, for the sublimation of sal ammoniac, for the concentration of sulphuric acid, &c. The advantage which will result from the change which I propose is beyond dispute; for, instead of twenty-four hours which are required for heating three gallies separately and successively, only fourteen hours will be necessary according to my method, so that a saving of five-twelfths in fuel, time, and labour, will accrue.

The

The furnace which I am about to describe is eight metres in length in each row; the proportions of width are the same as usual; only at the end of the first galley the passage for the caloric, instead of being perpendicular to the furnace, communicates, on the contrary, laterally and without separation, throughout the whole furnace.

Reference to Fig. 4, Plate XIII.

A, door of the furnace of the first galley.

B, aperture to produce a current of air at the commencement of the operation.

C, aperture similar to B, and for the same purpose.

D, door of the furnace of the second galley, which is opened as soon as the operation of the first is finished. If the first has been heated eight hours, the second requires only four hours to be heated to the same degree.

E, F, apertures for the same purpose as B and C.

G, door of the furnace of the third galley, which is opened when the operation of the second is finished; this third requires to be heated only one-fourth of the time necessary for completing the operation of the first.

H, aperture for the same purpose as E F and B C.

I, aperture serving for a flue to produce a powerful current of air, but which may be regulated in every stage of the operation by the greater or less width which may be given it.

Processes for preparing the Black Oxyde of Iron, or Martial Ethiops. By J. B. De Roover.

From Van Mons' Journal de Chimie, et de Physique.

1. Take iron filings, as little carburated, or as soft as possible; fill three quarters of the capacity of an iron boiler with them, and add water so as to form them into a consistent paste, in which the water is perfectly incorporated. After some time, according as the atmosphere is more or less hot, the matter will begin to heat itself. Stir it from time to time, in order that it may present new surfaces to the air, and that the evaporation of the moisture may be promoted.

If, when the matter is dry, the conversion of the iron into ethiops is not sufficiently complete, moisten it again with water, and to dry it proceed as above.

We might indeed repeat these fresh additions of water as long as there remains any iron to be oxydated; but it is more advantageous to submit the residuous iron, after having separated the ethiops, to new operations.

When the matter is dry the second time, pound it in a mortar, in order to break the cohering masses, and pass it first through a coarse hair-sieve, and afterwards through a fine one of silk. By this method we run no risk of superoxydating the ethiops by its desiccation in the air or by fire, after it is decanted.

According to this method of proceeding, the iron, which we must take care to have perfectly metallic, becomes oxydated partly at the expense of the water, and partly at the expense of the air, by the intermediation of this liquid. In these two cases of appropriation of oxygene,

ygene, caloric is set free: in the first case, by the passage of the oxygene of the water into a combination which renders it more fixed, or in which it is united with less caloric; and in the second, as it were naturally, by the decomposition of the air. The heat thus produced is sufficient to dry the matter; but when we operate with iron in part oxydated, and especially when it is in the yellow state of oxydation, the black oxydation takes place principally by the partition of the oxygene between the oxyde and the metallic iron, and only very little air and water are decomposed. As in this case the matter heats itself but little, the oxygene being almost of the quality of that which the iron combines in its state of black oxyde, it becomes necessary to apply external heat, both in order to aid the work of the partition of the oxygene *, and to dry the matter. Under these circumstances, therefore, we ought to proceed in the following manner.

2. Put the mixture of oxyde of iron and of metallic iron, whether we find it in that state, or reduce it thereto, into an iron boiler, and form it with water into a paste sufficiently liquid for the water to run off. Place the boiler upon a fire covered with ashes, and stir the matter till it is sufficiently dry. Then let it cool, triturate it, and pass it through a sieve.

The iron which remains may be treated in the same manner, by adding new red oxyde, or it may be treated in the cold, according to the first process.

* This partition of the oxygene between the metallic iron and the red or yellow oxyde, proves that the oxygene of this metal is less condensed at a second than at a first degree of oxydation.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Method of purifying Water for domestic Purposes.

IT was some years since discovered by M. Lowitz, of the Academy of St. Petersburg, that charcoal might be employed with success as a porous filtre, without smell, and not liable to be decomposed by the action of fluids. This observation has recently been applied to various purposes of domestic economy; and M. Cadet de Vaux has described a method of purifying honey and treacle by this medium. M. Siauve has submitted to the Agricultural Society of the department of Vienne, a plan for refining and increasing the salubrity of water employed for domestic uses, and separating from it the particles of selenite which produce those incrustations that are frequently formed in culinary utensils. The method recommended by him is the following: take a common water-butt, in the middle of which place a horizontal false bottom, perforated with a great number of holes. The lower division of the butt is intended to receive the water, and the upper must be filled with pieces of charcoal. Underneath the cock, by which the water enters the butt, is placed a perforated cylinder, to prevent the force of its fall from breaking the charcoal, and washing the dirt through into the lower receptacle. He likewise recommends this method to be adopted with regard to the water intended for the use of cattle, particularly during the dog-days.

Method

Method of making a Blue Colour with Turnsol.

M. Van den Sande has discovered that a very beautiful and solid blue paint may be made with turnsol. For this purpose he employs the following process: take good turnsol, and boil it for a moment with a greater or less quantity of alum (according as you wish to obtain a colour more or less dark) and water. Strain the liquor through paper, and precipitate it with the ley of potash, a small excess of which must be added to the decomposition of the alum. This excess of potash gives the paint its blue colour, which it likewise preserves. Take the deposit, and, without washing, make it into cakes to be dried. This colour must not be employed with acid ingredients which would turn it red; nor should it be exposed to acid vapours till the articles for which it has been used have been covered with varnish.

Hydrophobia cured by Galvanism.

By experiments made at Turin, by Professor Rossi, on two persons bitten by mad dogs, and who began in consequence to experience alarming symptoms, it appears that the operation of Galvanism is productive of the most beneficial effects in hydrophobia. In the above-mentioned cases M. Rossi effected a perfect cure.

Mineralogical Collection.

The Managers of the Royal Institution have it in contemplation to connect with it an extensive and useful collection of minerals, so as to establish there, on a large scale, an assay office, for the improvement of mineralogy and metallurgy. The fund to be raised to accomplish this design is intended to be applied under the direction of mineralogists and chemists to the following purposes: the formation of a scientific collection of minerals on such

a scale

a scale as to include the latest discoveries; the arrangement of the collection in such a manner as to exhibit all the interesting series of mineralogical facts; and the establishment of an assay office, to be exclusively employed for the advancement of mineralogy and metallurgy.

New Mode of Telegraphic Communication.

M. Vloers, a physician at Antwerp, who has been blind for the last twenty years, has invented a language for telegraphic communication, which is equally admirable for its simplicity, expedition, and universality. Persons who cannot even read or write may in a few days be instructed in the secrets of this art sufficiently to keep the notes, and to explain them. By means of what the inventor terms his great telegraph, he declares that he can transmit communications from Antwerp to Rome in eighteen minutes; but for this the telegraphs ought to be erected at the distance of three leagues from each other. In this manner a discourse of any length, and of any nature, may be conveyed; and, what is most extraordinary, this takes place without any apparent sign. M. Vloers has likewise invented an universal language, and a method of writing for persons who know only how to read, which may be taught in a few hours.

Ointment for healing Wounds in Trees.

The "Bulletin des Sciences" mentions an ointment, invented by M. d'Edelcrantz, which has been found very effectual in healing wounds in trees. It consists of varnish, or common linseed oil, rendered very drying, (by boiling it, for the space of an hour, with an ounce of litharge to each pound of oil,) mixed with calcined bones, pulverized and sifted, to the consistence of an almost liquid paste. With this paste the wounds of the trees are covered,

covered, by means of a brush, after the bark and other substance have been pared so as to render the whole as smooth and even as possible. The varnish must be applied in dry weather, in order that it may attach itself properly.

Discovery of a new Earth called Ochroite.

M. Klaproth has discovered in a mineral brought from Norway, under the name of *Tungsten*, a new earth; one of the principal characters of which is to acquire a brown colour by calcination. He terms it *ochroite*.

Meteorology.

The following is an account of the depth of rain fallen in Liverpool in the first six months of 1804, and the evaporation of water out of a vessel four inches diameter, placed out of the reach of the solar rays, or influence of fire. Continued from vol. IV. p. 239.

	Fall of Rain.	Evaporation of Water, &c.
	Inches.	Inches.
January	3,20	0,75
February	,99	1,10
March	2,50	1,50
April	1,75	1,75
May	3,	2,80
June	1,22	3,50
Total . . .	12,66	11,4

As measured by G. J. Liverpool.

Instrument for measuring the Strength of Wind.

Professor Paschmann, of St. Petersburg, has invented an anemometer, by which not only the strength of the wind may be exactly measured, but by means of other instruments, which are easily adjusted to it, such as an hygrometer, thermometer, and barometer, a variety of other physical experiments may be conducted with the greatest convenience.

Substitute for Salt of Sorrel for removing Ink-spots and Iron-moulds.

Take six parts of crystals of tartar, in powder, three parts of alum, likewise pulverized, and use them in the same manner as salt of sorrel.

List of Patents for Inventions, &c.

(Continued from Page 240.)

WILLIAM HAWKES, the younger, of Gateshead, in the county of Durham, Iron-manufacturer; for sundry improvements in constructing and making chains for the use of mines, and other purposes. Dated July 2, 1804.

ERRATA IN OUR LAST NUMBER.

Page 228, lines 11 and 12, *for* superabundant *read* supernatant.
230 3, *for* breaking *read* treating.
234 1, *for* some *read* somewhat.
235 2, *for* DE ROOVAS *read* DE ROOVER.
236 8, *for* so gros *read* ten drams.
ibid. 27, *for* odorus *read* odors.
239 18, *for* spontaneous *read* saponaceous.

Re-publication of Dr. Mavor's Universal History, in Monthly Volumes.

This Day, October the First, is published, price 3s. 9d. in Boards, or 4s. in Morocco Backs and Lettered, or on fine and large Paper, price 5s. in Boards, or 5s. 6d. half-bound in Morocco,

THE FIRST VOLUME,

(A Volume to be published on the First Day of every Month, till the Nine Volumes of the Ancient Part, and the Sixteen Volumes of the Modern Part, are completed,)

OF

A UNIVERSAL HISTORY,

ANCIENT AND MODERN,

Comprehending a General View of the Transactions of every Nation, Kingdom, and Empire, on the Globe, from the earliest Accounts of Time to the General Peace of 1802, to be completed in Twenty-five Volumes,

By WILLIAM MAVOR, LL. D.

Vicar of Hurley in Berkshire, Chaplain to the Earl of Moira, Author of the British Nepos, &c. &c.

The English language has hitherto been without any complete and popular view of Universal History. It will be immediately confessed by every competent judge, that Bossuet is at once too short and unsatisfactory; that Voltaire is too gay and desultory; and that the great English Universal History is rather to be consulted like a dictionary, than to be perused as an analysis of the subject to which it relates. What these writers have not done, has been attempted by the author of the present work. He has been solicitous to avoid the extremes of prolixity and brevity; to be distinct, pleasing, and comprehensive. This work has, therefore, proved a valuable acquisition to young persons, to public schools, to ladies, to circulating-libraries, and, in general, to all persons who do not make literature the sole business of their lives, and to whom the Universal History, in sixty-six large volumes, is either too voluminous or too expensive.

N. B. Those persons who may choose to purchase the entire work, without waiting for the monthly publication, are informed that the two editions may be had of all Booksellers, done up in the three kinds of bindings at the following prices:

Common Paper	complete	in boards	- - -	£ 4	13	6
Ditto	Ditto - - -	half-bound	- - - -	5	0	0
Ditto	Ditto - - -	calf-gilt	- - - -	5	15	6
Fine and Large Paper		in boards	- - - -	6	5	0
Ditto	Ditto - - -	half-bound	- - - -	6	16	6
Ditto	Ditto - - -	calf-gilt	- - - -	7	10	0

Printed for RICHARD PHILLIPS, No. 71, St. Paul's Church-yard; and to be had of all Booksellers in the British Dominions.

Printed by Roden *and* Lewis, *Paternoster-row.*

Cheap Publication of Contemporary Voyages and Travels.

On THURSDAY, NOVEMBER 1, 1804.

Will be published, elegantly printed in Octavo, embellished with various Engravings,

No. I.—Price Half-a-crown,

(To be continued Monthly) Of

A GENERAL HISTORY

OF

Modern and Contemporary

VOYAGES AND TRAVELS,

Intended to exhibit a faithful and satisfactory View of the Publications of distinguished Modern Voyagers and Travellers as soon as they appear, whether in our own or in any other Language.

It is the object of this work to enable the public, at a moderate cost, to keep pace with the Discoveries and Observations of MODERN VOYAGERS and TRAVELLERS of every nation. The enormous Expence of this class of books, has been a subject of just complaint to Purchasers of moderate fortune, and Publishers have frequently been deterred by the number and magnitude of the embellishments, from naturalizing many splendid and valuable foreign works of this description. It is therefore presumed, that a publication like the present, whose object is to retrench all superfluous expence, and gratify at once both the curious and the learned, by *translating* all foreign works of merit, and *analysing* all English ones, will be received with general approbation.

The early numbers will contain the Translation of CASSAS's Picturesque Travels in Istria and Dalmatia, lately published in Paris at sixteen guineas; KUTTNER's recent Travels in Denmark and Sweden, and of the various interesting and expensive Voyages and Travels that have been lately brought out, under the patronage of the French government. They will also include copious Analyses of several valuable books that have just appeared in the English language, among which will be BARROW's Travels in China, HOLCROFT's Travels in France, &c. &c.

OUTLINES OF THE PLAN.

1. This publication will exhibit a faithful History of every valuable work of Voyages and Travels, as it may appear from time to time, either in our own country or on the Continent, and whose expensiveness of form would be likely to prevent its translation, or general circulation.

2. Original Voyages, Travels, and Tours of merit, will occasionally be introduced, the copy-right of which will be purchased exclusively for this work.

3. Every number will contain from six to eight sheets of demy octavo, printed in the manner of the Monthly Review, and embellished with elegant engravings, maps, charts, &c.

4 Six numbers will form a volume, to which will be subjoined a copious index; consequently, two volumes will be completed annually.

On the whole, the Proprietor entertains the belief, that for the very moderate sum of thirty shillings a-year, as much information and entertainment may be purchased in this work, as in separate Voyages and Travels would amount to as many guineas.

Printed for RICHARD PHILLIPS, No. 71, St. Paul's Church-yard, and to be had regularly as published, of all Booksellers, Stationers, and Newscarriers, in the United Kingdom.

London, October 1, 1804.

WORKS

LATELY PUBLISHED BY

LONGMAN, HURST, REES, AND ORME,

No. 39, Paternoster-Row.

I.

THE ANNUAL REVIEW and HISTORY of LITERATURE; Vol. I. for 1802, and Vol. II. for 1803. In Royal Octavo, Price 1*l.* 1*s.* each, in extra Boards.

A. AIKIN, Editor.

⁂ The Advantages which recommend this Work are the following:

1st, *The Novelty of its Plan*, by which, instead of a confused Mixture, the various Works are arranged into Chapters, agreeably to their respective Subjects, as, Chapter I. Voyages and Travels; Chapter II. Theology, &c. &c. &c. By reviewing together the Works of a Year, the Publications are sufficiently numerous to render each Chapter important and interesting, and the Reader may select for Perusal those Chapters which best suit his Taste or his Pursuits. The Arrangement presents an historical View of the annual Progress of Literature and Science, and peculiarly adapts the Work for a Place in the Library. An annual well-arranged Volume may also be preferred to the Trouble of a frequent Delivery of Numbers on desultory Subjects, most of which have been anticipated by the present Work. For those Persons residing at a Distance from the Metropolis, and for Exportation, it must prove more particularly acceptable.

2d, *It is more complete*, inasmuch as each Volume forms a Whole, and comprehends a greater Number of Articles than the other Reviews. Its Table of Contents is indeed the completest Catalogue of recent Publications extant, and forms, with the Criticisms, an excellent Guide in the Choice of an annual Assortment of new Books.

3dly, *It is much cheaper* than any of the Monthly Reviews, although containing an equal Quantity of Matter, being sold for 1*l.* 1*s.* and their annual Subscription being 1*l.* 19*s.*

4thly, *It is so much earlier* in its Notice of literary Productions as almost wholly to anticipate every similar Publication. When the Second Volume was published, not one-third of the Works it reviewed (500 in number) had been brought forward in either of the other Critical Journals.

5thly, The Editor having been so fortunate as to engage independent professional Gentlemen of acknowledged Talents in every Department of Literature and Science, the Subscribers may rely upon the most able and impartial Judgment upon the Works reviewed.

N. B. Volume III. for 1804, will be published in March, 1805.

THE NEW CYCLOPÆDIA; or UNIVERSAL DICTIONARY of ARTS, SCIENCES and LITERATURE. Formed upon a more enlarged Plan of Arrangement than the Dictionary of Mr. CHAMBERS; comprehending the various Articles of that Work, with Additions and Improvements; together with the new Subjects of Biography, Geography, and History: adapted to the preſent State of Literature and Science. By ABRAHAM REES, D.D. F.R.S. Editor of the last Edition of Mr. Chambers's Dictionary; with the Aſſiſtance of eminent profeſſional Gentlemen. Illuſtrated by new Plates, including Maps, designed and engraved for this Work by some of the most diſtinguiſhed Artists. Parts I. to VII. in 4to. price 18s. each, in Boards.

*** Seven Parts of this magnificent Work being now before the Public, which have obtained a very extensive Circulation, the Proprietors may be allowed to state the Pretensions which recommend the Undertaking to the Public Notice, and render it worthy of their Patronage.

1. The Plan of this Work is intended as an Improvement upon similar Publications, being a Medium between the Plan of a Dictionary, and that of Treatises; and comprehending the Advantages of each. The History and Outlines of each Science are given under its appropriate Title; and its various Divisions, which can be more satisfactorily explained in separate Articles than in the Body of the Treatise, are introduced under their respective Terms. This is indeed the only proper Plan of a Dictionary intended for Reference when Information is required, which is expected to be found under its most ready and familiar Term in the Alphabet.

2. The Editor is of acknowledged Learning and Industry, and of unquestionable Experience in this Department of literary Labour, the greater Part of his Life having been employed in editing and improving the last Edition of Mr. Chambers's Dictionary, and in collecting Materials for the preſent Work.

3. The Gentlemen who have engaged to contribute their Assistance are of the first Eminence in their respective Professions. Among their Names are the following:

J. ABERNETHY, Esq. F.R.S.;
Mr. ARTHUR AIKIN;
C. R. AIKIN, Esq.;
Mr. E. AIKIN;
R. BLAND, M.D. A.S.S.;
C. BURNEY, MUS. D. F.R.S.;
WILLIAM BLAIR, Esq. A.M.;
Mr. JOHN BONNYCASTLE;
Mr. BRACY CLARK, F.L.S. Veterinary Surgeon;
Mr. E. DONOVAN, F.L.S.;
R. W. DICKSON, M.D.;
HUMPHREY DAVY, Esq.;
JOHN FLAXMAN, Esq. R.A.;
WM. MORGAN, Esq. F.R.S.;
JAMES MACARTNEY, Esq.;
A. MACKAY, LL.D. F.R.S. Ed.;
Mr. MUSHETT;
GEO. NAYLER, Esq. F.S.A. York Herald;
Mr. WILLIAM NICHOLSON;
JOHN OPIE, Esq. R.A.;
RICH. PEARSON, M.D. F.S.A;
Rev. WM. TOOKE, F.R.S;
SHARON TURNER, Esq. F.S.A.
Mr. CHARLES TAYLOR;
Mr. J. THOMSON; and
The Rev. W. WOOD:

and the Liſt is continually augmenting, no Opportunity being neglected to engage the co-operation of any Gentleman whose Service can be of real Utility.

4. The Work is handsomely printed by ANDREW STRAHAN, Esq. Printer to his Majeſty, upon a fine yellow woven Paper.

5. The Embelliſhments are of a very superior Description, and will form, when completed, an incomparably more elegant and correct Set of Scientific and other Plates than has ever been produced. The Scientific Subjects are engraved by Mr. Lowry, whose accurate Knowledge and improved Method of execution, in this Branch of the Art, has not been equalled. The Subjects of Natural History, &c. are chiefly engraved by Mr. Milton, with corresponding Taſte and Beauty.

6. A Part, or Half Volume, price 18s. each, has hitherto been published once in about Four Months; and, in consequence of some Arrangements lately adopted, the Public may with Confidence rely upon a more frequent Publication.

7. A few Copies are printed off on Royal Paper, with Proof Impressions of the Plates, price 1l. 16s. each part.

III.

THE COMPLETE NAVIGATOR; or, an EASY and FAMILIAR GUIDE to the THEORY and PRACTICE of NAVIGATION, with all the Requisite Tables, &c. &c. By ANDREW MACKAY, LL.D. F.R.S. Ed. &c. &c. Author of "Theory and Practice of finding the Longitude at Sea or Land," &c. In one large Volume, octavo, illustrated with Engravings, &c. Price 10s. 6d.

The Utility of the Art of Navigation to every commercial and Maritime State is obvious; but to none more so than to Britain; and, as the Lives and Fortunes of many depend upon the Accuracy of the Rules and Tables given in the Books published on this Subject, the greatest Care imaginable ought, therefore, to be taken in order to have them correct. This is not the Case, however, with some of the most popular Books; of which a few Instances are pointed out in the Preface of the present Work, and which was one of the principal Reasons for embarking in this Undertaking. The Author has spared neither Labor nor Expence to render it deserving of the public Attention, and as perfect as possible. The Work is divided into six Books, in the following Manner:

Book first contains—Definitions and Principles necessary as an Introduction to Navigation—An Account of the various Instruments which have been proposed to ascertain the Distance run in a given Time—The Description of a steering Compass—An Account of the Tides, with various Methods of finding the Time of High Water at any given Place—The Description of Gunter's Scale—A few of those Definitions and Propositions in Geometry necessary to understand the Theory of Navigation—and Plane Trigonometry.

Book second contains the several Sailings commonly used in Navigation. The first five of these Sailings, namely, *Plane, Traverse, Parallel, Middle Latitude*, and *Mercator's Sailings*, are resolved by Construction, Calculation, Inspection, and by Gunter's Scale. The other Sailings being less used, are, therefore, only resolved by the first two of these Methods. To this second Book are added various Methods of constructing both Plane and Mercator's Charts.

The third Book contains the Description, Rectification, and Manner of using Hadley's Quadrant and Sextant, together with the Method of finding the Latitude and Longitude of a Ship at Sea, and the Variation of the Compass, from Observation.

In the fourth Book is an Account of a Sea Journal, with Precepts for performing the same, exemplified in a Journal proper for a long Voyage.

The fifth Book contains—The Application of Trigonometry to the Mensuration of Heights and Distances—The Manner of surveying Coasts and Harbours illustrated by an Example—An Account of the Winds—On predicting the Weather.

Book sixth contains the Tables, which are more extensive than in any other Book upon Navigation; with an Explanation prefixed.

IV.

A Collection of MATHEMATICAL TABLES, for the Use of STUDENTS in UNIVERSITIES and ACADEMIES, for the PRACTICAL NAVIGATOR, GEOGRAPHER, and SURVEYOR, for MEN in BUSINESS, &c. &c.

By ANDREW MACKAY, LL.D. F.R.S. Ed. &c. &c.

Author of the Theory and Practice of finding the Longitude at Sea or Land, &c.

In One Volume, Octavo, Price 7s. in Boards.

V.

An ESSAY on NAVAL TACTICS, Systematical and Historical, with Sixty-three Explanatory Plates, in Four Parts.

By JOHN CLERK, Esq. of Elden.

The Second Edition, in Quarto, price 1l. 16s. in Boards.

⁂ To the System of Manœuvres, laid down and explained in this Work, the British Nation are indebted for those splendid and decisive Naval Victories, which their Fleets have gained since the latter End of the American War. Lord Rodney first adopted and followed the Mode of Attack recommended by Mr. Clerk; and the Success which attended this new Mode has since recommended it to our most celebrated and successful Admirals. The Principles on which it is founded are plain, simple, and incontrovertible.

VI.

The SHOOTING DIRECTORY. By R. B. THORNHILL, Esq.

Vide! Lege! Crede!

In One Volume Quarto, with Plates, price 1l. 11s. 6d. in Boards. Also a superior Edition, with the Plates coloured after Life, price 3l. 3s. in Boards.

☞ The Subscribers to this Work are respectfully informed they can have their Copies on Application to their respective Booksellers, or to Messrs. LONGMAN, HURST, REES, and ORME, No. 39, Paternoster-Row.

⁂ The Attention of every Sportsman is requested to this Work, as it is presumed it will be found the completest Compilation yet published on Shooting, to which it is entirely confined. It is embellished with Engravings by Medland, the Designs of which were taken from Life on the Ground.

It treats largely and minutely on the following subjects: Dogs, Table of British Dogs, Management of ditto, Breeding of ditto, Pointer, Setter, Spaniel, Cocker, Grous, Partridge, Pheasant, Woodcock, Snipe, Hare, Fowling Piece, Recoil, Range of Barrels, Loading of ditto, Scattering of ditto, Double ditto, Patent Breech, Gunpowder, Shot, Game Laws, Certificate, Game Laws respecting Grous, Black Game, Bustard, Partridge, Pheasant, and Hares; Stealing of Dogs, Duty on ditto, Distemper, Shooting, and a great number of very valuable Receipts, and various other Subjects too numerous to come within the Limits of an Advertisement; and it is to be hoped, that after a perusal of this Work, the Price will be considered small, when compared with the Prices of all the other Publications on this Subject.